AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 12, No. 7. WEEKLY. | NEW YORK, THURSDAY, FEBRUARY 14, 1889. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

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U. S. Pneumatic Dynamite Gun Cruiser "Vesuvius."

The accompanying illustrations represent a longitudinal section and deck plans of the U. S. Pneumatic Dynamite Gun Cruiser "Vesuvius," referred to in our issue of the 10th ult. For the sake of completeness and ready reference, we shall again give its principal dimensions :

Length	246	feet.
Breadth	26½	"
Mean draft	8½	"
Tons displacement	700	

Cruiser is made of steel.

Machinery, vertical triple.

Expansion twin screw engines.

Each engine has one high-pressure cylinder, 21½ inches diameter; one intermediate cylinder, 31 inches diameter, and two low-pressure cylinders, 34 inches diameter; stroke of all, 20 inches. These, and the auxiliary engines combined, develop 4,400 horse-power. Steam is furnished by four cylindrical locomotive boilers, having 200 square feet of grate surface; steam pressure, 160 pounds. The ship is steered by steam.

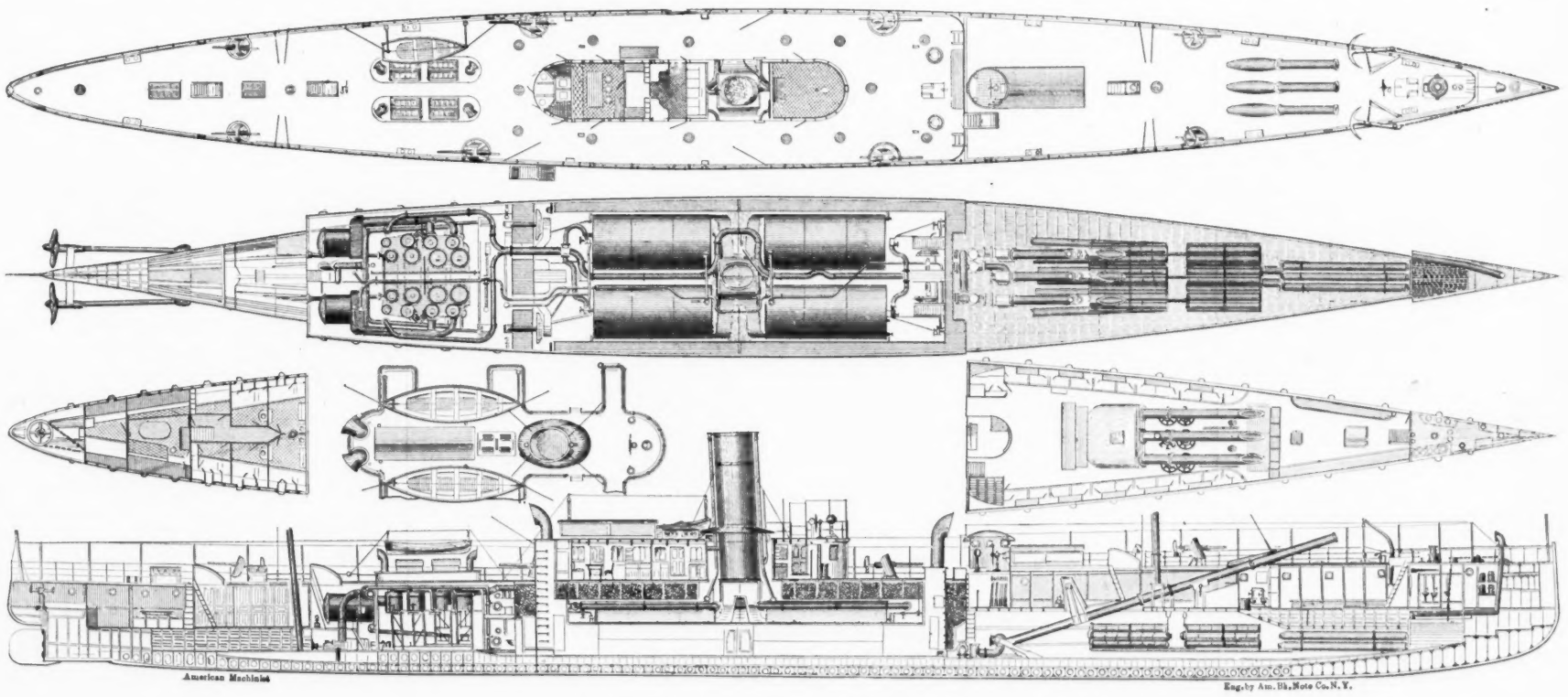
Her builders, Wm. Cramp & Sons, guaranteed a speed of 20 knots, but during her last trial trip a speed of 21.64 knots was obtained, demonstrating the fact that, as far as speed is concerned, the new cruiser is a great success.

The interest of naval men is now concentrated on the pneumatic dynamite guns. These, as will be seen, are placed well forward, and are built into the ship. They pierce the upper deck with the muzzles pointing forward, and extend to the bottom of the hold. Three of these guns are placed side by side, as will be seen in the deck plan; they are 15 inches bore, 54 feet long, and have an elevation of 18 degrees. In comparison with ordinary powder guns, they are very light, and not rifled. At the lower end of each gun, and forward of the same, there are placed two revolving cylinders, each containing five chambers for holding as many projectiles. To load the gun its breech is swung downwards, so as to bring it in line with a chamber in the revolving cylinder. By means of a hydraulic ram, the projectile is pushed into the breech, which is then swung upward, thus again completing the continuity of the barrel.

The body of each projectile is about 7 feet long, not including its rear shaft, to which are fitted spiral vanes, to secure its alignment and rotation. Each projectile is charged with 600 pounds of high explosive, dynamite or gelatine. The body is made of thin drawn brass tubing; the total weight of projectile, when charged, is about 1,500 pounds. It is said that the cost of each projectile, with explosives, is about $900, whereas the cost of a shot for a 15-inch Krupp gun is estimated to be nearly double that amount. All the operations of the vessel will be directed by the officers stationed in the tower, on the upper deck. This tower is protected by light armor, and is situated nearly in a vertical plane, through the lower ends of the guns. These officers keep the target well in view, and steer the ship into proper position. An indicator or reflector below deck enables the gunnery officer at the breech of the guns to calculate the exact amount of air pressure necessary to hurl the projectile on the deck of an enemy; since the guns have a fixed elevation, the range is varied as may be required, by admitting more or less air.

In order to test the accuracy with which projectiles can be thrown from these guns, several official trials have been made with a 15-inch pneumatic gun, mounted at Fort Lafayette.

The projectiles used in these experiments were smaller than those which are to be used on the "Vesuvius," containing only about 175 pounds of dynamite; and one is said to have contained 500 pounds. Although the pneumatic gun is yet in an experimental stage, and much may have to be done to improve and perfect it, the experiments were very satisfactory to the advocates of this mode of warfare. The official programme was not carried out in all instances, yet the results of the experiments seem to prove, beyond a doubt, that large quantities of high explosives can be discharged with safety from these guns. There are also good grounds for expecting, as some experts claim, that a greater accuracy in firing—under all conditions—can be obtained with these than with the ordinary powder gun. Six out of eight projectiles, thrown during the last trial, fell within a parallelogram 50 feet wide and 150 feet long. The average range was about 2,100 yards; average flight, about 13 seconds; average elevation, 18 degrees; and an average air pressure of about 1,000 pounds. Of course it must be remembered that these projectiles were lighter than those which are to be used on the cruiser "Vesuvius."



U. S. PNEUMATIC DYNAMITE GUN CRUISER "VESUVIUS."

The Milling Machine and its Operations.

No. 2.

A TRUE ARBOR AND CUTTERS—HOW TO MAKE THEM.

By A. B. LANDIS.

In my last article I gave my experience with milling machine arbors that were out of truth, in connection with round supporting arms. In this article I propose to give my plan for maintaining a true arbor, since it is always more to be preferred to have a true arbor than otherwise, although I gave my plans of overcoming a trouble experienced with them. An arbor sprung out of truth in the manner before set forth, and the remedy described for that particular work, will not at all times bring about desirable results in surface milling, since the arbor may be slightly out of truth between the spindle and center, and therefore cause the miller to cut only on one side, and make wavy work.

There are a number of points to be looked up and watched with great care, to preserve a true arbor. The first essential thing would be to be sure the hole in the spindle is true (once proven, however, is sufficient), then to see that the arbor is true on its centers throughout its length. In making, it should be finished throughout by grinding. The next thing is to have the collars used on the arbor faced true on each end; then the cutter with a ground-out hole to fit the arbor closely, and its sides ground true and parallel with each other, and the teeth ground true with the holes, and lastly put together clean of any dirt in the joint of the collars. If these conditions are carried out, a true arbor will always be the result. But to do this, you must have some facilities, especially in the case of the milling cutter, to have its side ground true and parallel. The idea of ground sides of millers is not new; but I have seen a great many in use which were used as they came from the tempering process; and no matter how true they were faced before tempering, they are not to be depended upon as such afterward. A slight variation in the thickness of the cutter will invariably make an arbor run out of truth.

In Figs. 1 and 2 (page 2) of illustration is a plan I adopted for grinding the faces of cutters up to 4¼" thick. A piece of steel with a collar *d* is fitted in the grinder head spindle, with the outer end *c* ground to fit the standard holes of the cutter, which is bored and tapped to receive the screw *b*, operated with a screw-driver, the arbor being split into six parts. The face *a* is faced true by grinding (which operation should be repeated whenever placed into the machine to insure its truth), then I used several thicknesses of collars (as one shown), to bring the face of cutter over end of arbor *c*, according to thickness of cutter. These collars being once faced true, always serve their purpose. By putting

the cutter on the arbor, and holding it against the collar with two fingers while tightening the screw *b*, parallel sides will be produced. This device presents no advantages for doing its work over the one in use by Brown & Sharpe, and illustrated in these columns by John J. Grant, in the issue of Feb. 2, 1884, but it will do its work equally well, and no doubt is something cheaper to make.

In the case of the "Gang Milling," treated upon in my article in these columns in the issue of October 17, 1885 (wherein I treat upon other features of the case), I used thin saws, and as a great many were used, it was highly important that all should be parallel, in order to preserve a true arbor, and also they had to be equal thickness throughout, to preserve correct time or distance, so that a perfect job was obtained. For the grinding of these cutters I made a chuck, as shown in Fig. 3, made like a bell, and to screw on the grinding machine spindle. A shoulder *a* against which the cutter rests was carefully trued off each time put into the machine. The bell was split in six parts and a band, *b*, with lugs for a screw, and split, was slipped over the bell for the purpose of clamping the cutter. An opening, *c*, was cut at one of the slots for the purpose of admitting the micrometer caliper, by which means the whole cutter could be calipered from periphery to the hole, to insure its being correct at all points. By this same chuck the holes were also ground out to correct size. The cutters, after tempering, were all strung on an arbor, to fit the unfinished hole, and fastened with a nut, and the outside of the teeth ground off to fit this chuck, and the cutting clearance ground, after all was finished. The advantage of this chuck is its convenience for getting the cutters to correct size before removing them.

There is another error frequently made with milling arbors, and that is, they are adjusted to the center, and afterward the nut which holds the cutters is drawn up tightly, by which means the arbor is stretched, the center and the bearing of the machine are jammed, and when not noticed, damage of no small consequence is frequently done, as the bearings and center become roughed by abrasion, which causes them to heat and give trouble. This point should be watched, as novices will frequently make this blunder.

There was a case of this kind under my own observation, and left to me to remedy. I had to have the spindle re-ground to a smooth bearing and grind up the center points, and the center hole in the arbor as well, entailing loss of time and expense. Therefore a timely warning to the novice in this particular would avert the calamity.

In the case of dressing the center hole of the arbor I adopted the plan given in the columns of the AMERICAN MACHINIST some years ago (I cannot recall by whom), by using a copper center for the purpose, and by chucking a piece of copper in a chuck of the lathe, turning it to the correct angle of center (60°) by holding the arbor in the tail center and the end to be lapped out on the copper center, allowing a little play between the two. Use emery and oil on the copper, run the lathe at a high speed and turn the arbor, and work it endwise between the two centers. The reason for end moving is to prevent grinding ridges. After grinding a short time, remove the arbor, re-shape the copper center (as it grinds itself out of shape), and proceed as before. Repeat the operation until you have a smooth center hole and the copper center has retained the true shape. By carefully turning the arbor while lapping, there will not be much danger of having it out of truth.

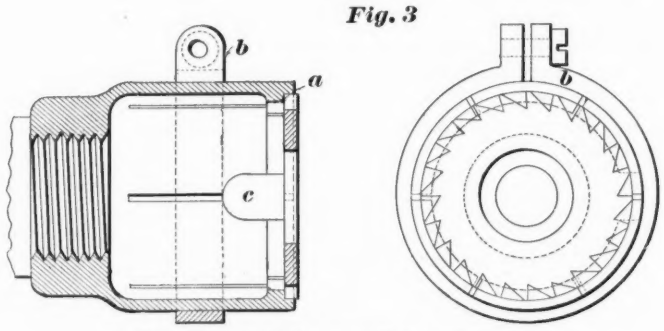
The arbor, illustrated by J. J. Grant in AMERICAN MACHINIST, issue of Sept. 15, 1883, would seem to present some nice points, in that it has a straight bearing and avoids the outward thrust upon the center head, which is the case with taper centers. But unless he uses an adjustable bearing, when once worn, it would chatter, through being loose, whereas the taper center is always adjustable.

The plan of making a center with very slight taper coming in contact in the bottom, something like a vertical shaft "step bearing," in my experience does not have much virtue, as it does not remain a smooth bearing, and is hard to correct. My preference is a large and deep center, which, properly handled, will give no trouble.

Novel Use of the Steam Engine Indicator.

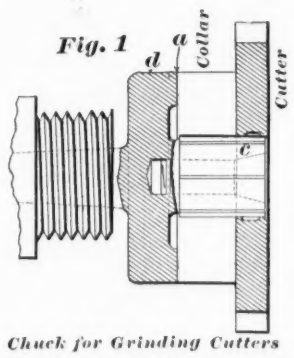
L. B. Breckenbridge, instructor in mechanical engineering in the Lehigh University, has been making some experiments to determine the pressure that comes on the table of a drill press when drilling cast-iron; the results of his experiments are published in the *Journal of the Engineering Society*, of that University. He made a cylinder, to which was accurately fitted a plunger having an area of ten square inches. Near the bottom of the plunger three small grooves were turned, to prevent leakage of the oil with which the cylinder was partly filled. Two holes were drilled in the cylinder, near the bottom, and a steam gauge and an indicator attached. The indicator cord was attached to the hub, on the shaft of the quick-return motion lever, so as to get diagrams of considerable length. With the piece being drilled resting on the plunger, it will be seen that a diagram could be taken that would show the pressure due to forcing the drill through the work.

Fig. 3



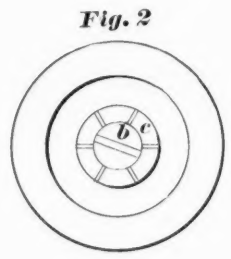
Chuck for Grinding small thin Cutters

Fig. 1



Chuck for Grinding Cutters

Fig. 2



THE MILLING MACHINE AND ITS OPERATIONS.—SEE PAGE 1.

The material drilled was cast-iron, twist drills, machine ground, being used. With ¼-drill the greatest downward pressure was 400 lbs, with ½-inch, 900 lbs; with ¾-inch, 1,100 lbs.; with 1-inch, 1,450 lbs.; and with 1¼-inch, 1,800 lbs. These were the pressures at starting; the pressure was generally less when the drills were cutting full size, in the instance of the 1-inch and 1¼-inch drills falling to 1,150 lbs. as the maximum.

Test of the Field-Stirling Boiler.

Mr. Allan Stirling, an engineer well known in New York and vicinity, has devised a modification of the Field Boiler, and formed a company in Canada for its manufacture. Something of what he is doing in this respect may be gathered from the following extract which we make from *The Montreal Daily Witness*. We may add that the manufacture of these boilers will be carried on extensively in this country:

In a description of the Field-Stirling Boiler, which we published some time ago, we promised to give the results of the first complete scientific test of one of these boilers.

The boiler of this type recently erected in the St. Patrick street works of the Pillow & Hersey Co., by the Dominion Safety Boiler Co., and rated by them at 200 horse-power, was tested up to 255 pounds' cold water pressure per square inch. On Friday, 18th inst., the superintendent of the works, Mr. John R. Hersey, C. E., assisted by his brother, Mr. Theo. Hersey, C. E., tested its efficiency in the presence of its inventor, Mr. Allan Stirling, M. E. They established that the boiler evaporated eleven and three-quarter pounds of water per pound of combustible, and it actually developed 252 horse-power. The fuel used was Intercolonial Run of Mine.

This brings our Montreal steam practice into the foremost place as regards boilers. Mr. Snow, the general superintendent of the Standard Oil Company, who has probably more boilers under his control than any other man on this continent, stated recently that the best result he ever obtained under the most favorable conditions, with the ordinary horizontal tubular boiler was nine pounds of evaporated water to a pound of combustible, and that the average results with these boilers will not exceed seven and a half pounds. The Heine boilers of the city water-works, which were tested recently, gave an efficiency with selected Scotch coal of seven and a quarter pounds, and with select Cumberland coal of nine and a half.

Practical Drawing.

BY J. G. A. MEYER.

SEVENTIETH PAPER.

EXAMPLES FOR PRACTICE.

Problem 81.

537. Let Fig. 435 (page 3) represent the vertical, and Fig. 436 the horizontal projection, of a cylinder intersected by a prism. In Fig. 435 we see the base *e f g h* of the given prism; and this base is a square, its diagonal *f h*, and the axis, 1*i f* of the given cylinder, lie in one and the same plane. In Fig. 436, we see the upper base of the cylinder, and also two of the four sides of the prism, $e_2\ g_2$ $e_4\ g_4$. It is required to find the development of the cylindrical surface. This development is represented by the shaded surface, Fig. 438.

To find this development, we simply consider that one-half of the given cylindrical surface, namely, the portion, *a c* 1*i f*, is intersected by the plane *e f*, and that the other half, *b d* 1*i f*, is intersected by the plane *f g*. The manner of finding the development of a cylindrical surface intersected by a plane surface has been explained in Problem 74, and the construction has been shown in Figs. 378, 380. True, in Problem 74, the cylindrical surface is intersected by one plane extending clear across the cylinder; whereas, in the problem before us, the given cylindrical surface is intersected by two planes at right angles to each other. These conditions do not change the principles of construction, but they do make a difference in the curved boundary line of the developments. Notice, for instance, the development shown in Fig. 380. There we find the curved boundary line to be a continuous curve, but in Fig. 438 the curved boundary line is made up of two curves, 1*l* 5*l* 9*l* and 9*l* 5 1*m*, and these curves are equal to each other. Following the principles of construction as shown in Fig. 380, we obtain the construction lines as shown in Figs. 435 and 436. It may also be stated that, if we compare the construction before us with that given in Figs. 404, 405, and 406, we find the two are similar, and if we know how to find the development shown in Fig. 406 and some of the following figures, we certainly should know how to find the development shown in Fig. 438. We shall, therefore, not give any further explanation, as such would only be a needless repetition of that which has been given before. Our object in giving this problem is simply for presenting an example for practice; and, particularly, to enable us to point out the fact that the curved boundary line in Fig. 438 cannot be a continuous curve, like those obtained in all previous problems.

Fig. 437 represents another elevation of the given cylinder and prism; of course, this view is not required for finding the development shown in Fig. 438. Our purpose of showing it here is to enable us to compare it presently with a similar view of another cylinder and prism such as is shown in Fig. 441.

Directions. In the space marked Problem 81, draw three views of a prism and cylinder like those shown in Figs. 435, 436, and 437. Let the base of the prism be 7 inches; length, 9½ inches; diameter of cylinder, 7 inches; height on the line *a c*, 6 inches. Find the development of the cylindrical surface. Use 1½ inch scale.

Problem 82.

538. *To find the development of a cylindrical surface intersected by a prism with a hexagonal base.*

Let Fig. 439 represent the vertical, and Fig. 440 the horizontal projection of the given cylinder and prism; it is required to find the development of the cylindrical surface.

There is really nothing new to be introduced in this problem; but, on account of the straight lines *t u*, *v w*, *x y* (Fig. 442), which, in connection with the curves *u* 5*t v* and *w* 5*y x*, form part of the boundary line of the required development, it is advisable to give a brief description of finding this development.

Divide the semi-circumference 1*p* 5*p* 9*p* (Fig. 440) into any number of equal parts, say eight, and through the points of division 2*p* 3*p* 4*p*, draw vertical lines cutting the face or side of the prism (Fig. 439) in the points 2*c* 3*c* 4*c*; and terminating in the upper base *a* 4*b* of the cylinder.

Fig. 442. Draw the horizontal line *d s* and make it equal to 3.1416 times the diameter *a* 4*b* of the given cylinder. Divide the line *d s* into sixteen equal parts; through the points of division 2*d*, 3*d*, etc., and also through the extremities *d* and *s* draw lines perpendicular to *d s*; make *d t* equal to *l m* (Fig. 439); 2*d* 2*t* equal 2*l* 2*c*; 3*d* 3*t* equal to 3*l* 3*c*; and so on in succession. So far, the construction is precisely like those given in Problem 76. But now notice, the lines *d t* and 2*d* 2*t* are equal in length, and this is as it should be, because the lines *l m* and 2*l* 2*c* (Fig. 439) are also equal to each other; consequently joining the extremities *t*, 2*t* of the lines *d t* and 2*d* 2*t* (Fig. 442), we obtain a straight line parallel to *d s*. Here, then, the question arises: How far beyond the line 2*d* 2*t* will the line *t* 2*t* extend? or, in other words: What is the distance between the point *u* and the line 2*d* 2*t*? This distance is readily found in Fig. 440; in this figure the point 2*p* represents the line 2*d* 2*t* shown in Fig. 442; and the point *u* (Fig. 440) represents the point *u* (Fig. 442); the true distance between the point *u* and the line represented by the point 2*p* is equal to the arc *u* 2*p*. We therefore make 2*t u* (Fig. 442) equal to *u* 2*p* (Fig. 440). It will be evident that, if the point *u* has been correctly laid off by the foregoing method, then the line *t u* must be equal to the arc 1*p u*.

In a similar manner find the points *v*, *w*, and *x*. Join the points *u*, 3*t*, . . *v*, by a curved line; also join the points *x* 3*y* . . . *w* by a curved line, and thus complete the development represented by the shaded surface, Fig. 442.

539. Another elevation of the cylinder and

hexagonal prism is shown in Fig. 441. A comparison of this figure with Fig. 437 may be an instructive one to the student. In Fig. 441 two sides of the prism are shown; in Fig. 437 there are also shown two sides of a prism; here, then, we have cases which show clearly the necessity of giving more than one view of an object to represent its form completely. If there are no other views given besides Figs. 441 and 437, we cannot tell whether a triangular, square, or hexagonal prism is meant; in fact, we are not sure that in these figures a prism is really shown. (See Art. 209.) If, on the other hand, we have Fig. 439 given in connection with Fig. 441, and Fig. 435 given in connection with Fig. 437, we have the prisms completely represented, and there is no doubt left as to what kind of prism is meant.

540. Now compare the curve of intersection $o_3\ b_5\ o$ in Fig. 441 with the curve of intersection $k_5\ b_5\ i_5$ in Fig. 437. The manner of finding these curves of intersection has been explained in Problem 59.

The curve $k_5\ b_5\ i_5$ (Fig. 437) is tangent to the elements $k_3\ k_5$ and $i_3\ i_5$ of the cylindrical surface; and, furthermore, because the line $e\ f$, in Fig. 435, forms an angle of 45 degrees with the element $a\ c$, the curve $k_5\ b_5\ i_5$ is a semi-circumference of a circle.

Now let us examine the curve of intersection $o_3\ b_5\ o$ in Fig. 441. This curve does not meet the elements $l_3\ l_5$, $p_3\ p_5$ of the cylindrical surface; the reason for this becomes apparent by referring to Fig. 439. In this figure we see that the line $g\ h$, representing one of the faces of the prism which intersect the cylindrical surface, does not extend to the center line $l\ m$, and, therefore, the face, $g\ h$, does not intersect all the elements of the cylindrical surface. But the line $g\ h$ and the rectangle $g_3\ h_3\ g_5\ h_5$ in Fig. 441 represent one and the same face of the prism, and since, as we have seen, this face does not intersect all the elements of the cylindrical surface, it follows that the curve of intersection $o_3\ b_5\ o$ cannot reach the elements $l_3\ l_5$, $p_3\ p_5$. Furthermore, because the line $g\ h$ (Fig. 439) forms an angle of less than 45 degrees with the element $a\ c$, the curve of intersection $o_3\ b_5\ o$ must be a portion of the circumference of an ellipse.

541. Since the curve of intersection $o_3\ b_5\ o$ does not extend to the elements $l_3\ l_5$, $p_3\ p_5$, and since in this respect it differs from the intersections obtained in any of the previous problems, the following explanation of finding this curve may aid the student, and possibly remove doubts from his mind.

The portion of the cylindrical surface intersected by the face $g\ h$ is represented in Fig. 440 by the arc $w\ 4r\ x$. Divide this arc into any number of equal parts, say six, and through the points of division $2r$, $3r$, draw vertical lines intersecting the line $g\ h$ (Fig. 439) in the points $2g$ $3g$, and terminating the upper base $a\ 4b$. One of the points of division, namely, $4r$, will fall on the horizontal line $5p\ 4r$, drawn through the center x_5 of the circle, and, consequently, the point $4r$ will be the horizontal projection of the element $4b$, $4g$.

Fig. 441. Draw the center line $b_3\ b_5$; this line, and the line $4b\ 4g$ in Fig. 439, also the point $4r$ in Fig. 440, will represent one and the same element in the given cylindrical surface. On the line $l_3\ p_3$, lay off a point 3, the distance between the points b_3 and 3 must be equal to the distance between the points r_3 $3r$ in Fig. 440; again, on the line $l_3\ p_3$ lay off the point 2, and make the distance between the points b_3 and 2 equal to r_3 $2r$; and lastly, on the line $g_3\ g_5$ lay off the point o_3; the distance between this point and the line $b_3\ b_5$ must be equal to that between x_1 and x. Through the points 2 and 3 draw vertical lines; make the line $2i\ 2$ equal to $2b\ 2g$ (Fig. 439); $3i\ 3$ equal to $3b\ 3g$; and $b_3\ b_5$ equal to $4b\ 4g$. Join the points $o_3\ 2i\ 3i\ b_5$ by a curve line; and in a similar manner construct the curve $b_5\ o$, which is an exact duplicate of the curve $b_5\ o_5$. The curve $o_3\ b_5\ o$ thus found will be the required curve of intersection.

Although Fig. 441 is not required for finding the development shown in Fig. 442, it is necessary that we should know how to make such a projection, as problems of similar character often present themselves in practice.

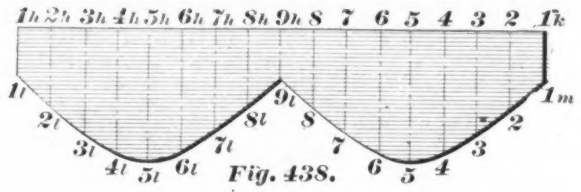


Fig. 438.

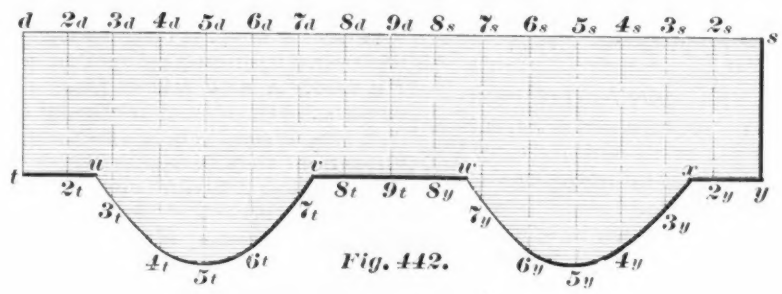


Fig. 442.

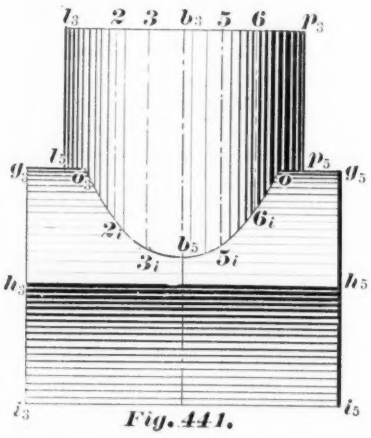
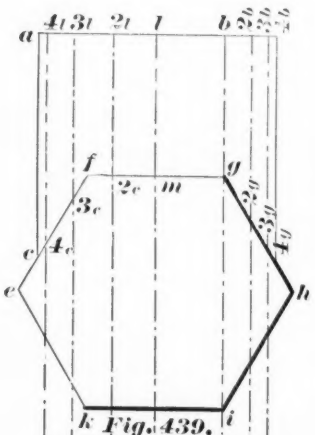


Fig. 441.



k Fig. 439.

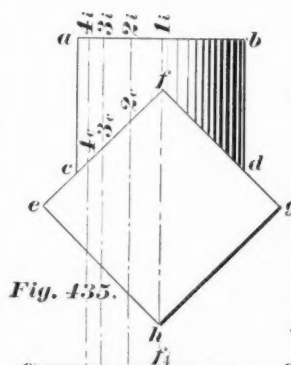


Fig. 435.

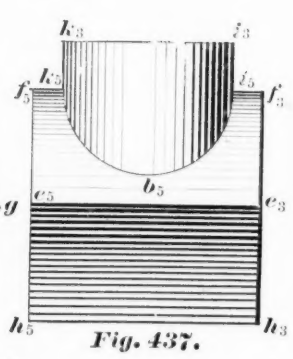


Fig. 437.

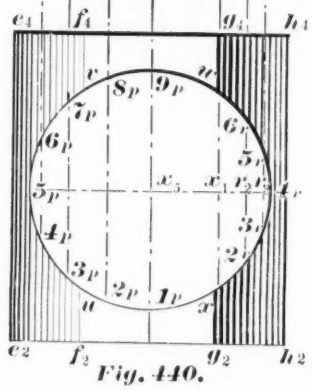


Fig. 440.

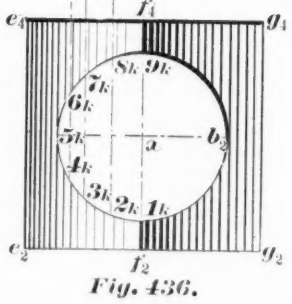


Fig. 436.

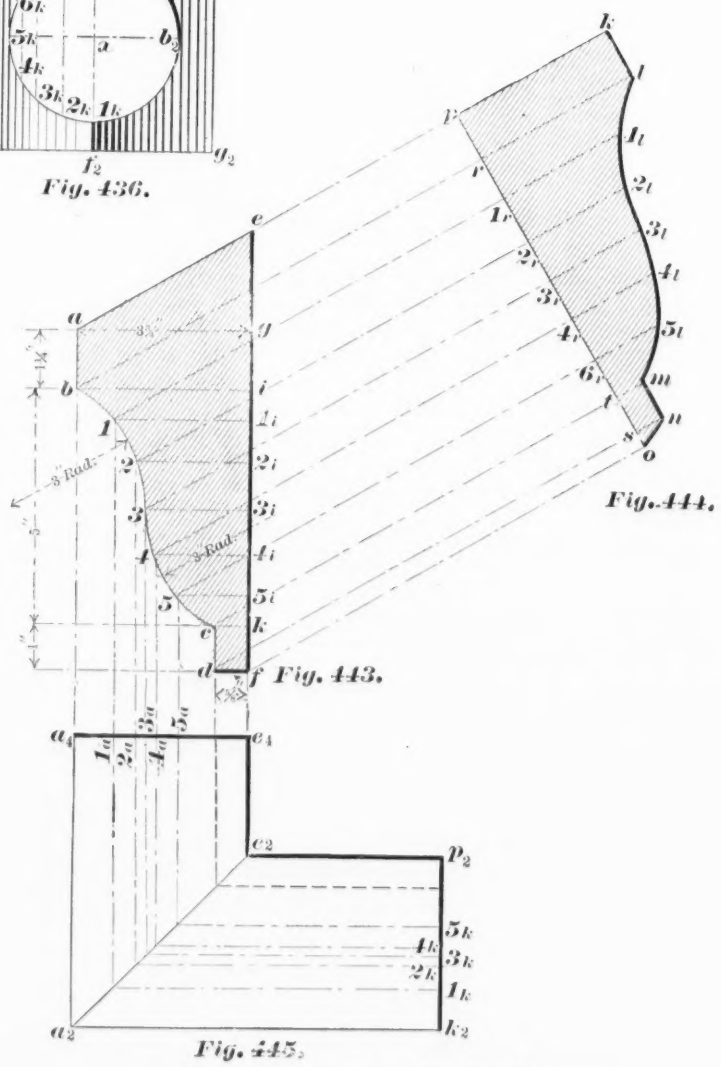


Fig. 443. Fig. 444. Fig. 445.

Problem 83.

542. Let $a\ b\ c\ d\ e\ f$, Fig. 443, represent the cross-section of a level crown moulding; it is required to find a corresponding raking moulding; the line $a\ k$ represents the given rake of the roof.

In the horizontal projection (Fig. 445) of these mouldings, the level crown moulding is represented by $a_2\ e_2\ a_4\ e_4$, the raking moulding is represented by $a_2\ e_2\ p_2\ k_2$; the line $a_2\ e_2$ represents the joint of these mouldings; and since the line $a_2\ e_2$ bisects the angle formed by the lines $a_2\ a_4$ and $a_2\ k_2$, it follows that the thickness of one moulding must be equal to that of the other one.

Fig. 443. Divide the curve $b\ c$ of the given moulding into any number of equal or unequal parts, and through the points of division 1, 2, 3, 4, 5, draw lines parallel to the line $a\ k$; also through the same points of division, and through the points a, b, c, draw lines perpendicular to $e\ f$, meeting the same in the points g, i, $1i$, $2i$, $3i$, $4i$, $5i$, and k. The lines $a\ g$, $b\ i$, $1\ 1i$, $2\ 2i$, etc., will be the thickness at given distances on level crown moulding. Fig. 444. At any convenient distance from $e\ f$ draw the line $p\ o$ perpendicular to $a\ k$, cutting the lines parallel to $a\ k$ in the points r, $1r$, $2r$, etc. Make $p\ k$ equal to $a\ g$ (not equal to $a\ c$); $r\ l$ equal to $b\ i$; $1r\ 1l$ equal to $1\ 1i$; $2r\ 2l$ equal $2\ 2i$, and so on in succession, and thus obtain the points $1l$, $2l$, $3l$, $4l$, $5l$. Make $t\ m$ equal to $c\ k$; $s\ n$ equal to $d\ f$; join the points o and n by a straight line; join the points m and n by a straight line; and also join the points k and l by a straight line. Lastly, join the points l, $1l$, $2l$, $3l$, $4l$, $5l$, and m by a curve, and thus complete the outline of the shaded surface, which is the cross-section of the required raking moulding.

Directions. In the space marked Problem 83, draw a section of a level crown moulding, as shown in Fig. 443; work to the dimensions given in the figure, and make the rake the same as shown. Find the cross-section of the raking moulding, such as is shown in Fig. 444. Use 3-inch scale.

Directions. In the space marked Prob. 82, draw three views of a prism, like those shown in Figs. 439, 440 and 441. The base of the prism, measured across corners e to h, is to be 6 inches; length of prism $6\frac{1}{4}$, inches; diameter of cylinder, $5\frac{3}{4}$ inches; height, $a\ c$, $3\frac{1}{2}$ inches. Find the development of the cylindrical surface. Use 3-inch scale.

In Problem 79 we have given the method for finding the smallest cross-section of an oblique cylinder. This method is also applicable to the solutions of many practical problems in which it is required to find the smallest cross-section of other bodies, which are not cylindrical. Let us take, for an example, the following practical problem:

The Railroad Commission of New York State complains that, in the systems so far introduced for heating cars by steam, no attention is paid to ventilation, and hence that the cars are uncomfortable. There are plenty of means known to science for ventilating rooms heated by steam, and whatever there may be in the way of heating cars by steam, there is no excuse for lack of ventilation. There are certainly means of getting air in and out of a rapidly moving railroad train. If the railroad companies can solve the problem of heating their trains by steam, the matter of ventilation should not cause them serious trouble.

It has been arranged that Professor H. G. Seeley, F. R. S., will deliver a course of lectures in Holborn Town Hall, Gray's Inn road, every Wednesday evening during February, at eight o'clock. This course is given at the request of the London Geological Field Class. The lectures will relate to the strata to be seen in the coming summer excursions of the class. A comparison will be made between the geological structure of localities to be visited, and the conditions of the same strata in other parts of England or the Continent. *The Engineer* (London).

Epicyclic Trains.

BY PROFESSOR A. T. WOODS.

While there are comparatively few examples of the application of epicyclic trains in modern machinery, they are nevertheless important, in that they furnish simple solutions to some problems in mechanism which could only be solved with difficulty by the common forms of gearing or belting.

An epicyclic train consists of a number of gear wheels, or pulleys, and belts, some of which are carried upon a revolving arm. For example, in Fig. 3, the wheel F is fastened to the shaft B, about which the arm A turns. This arm carries the axes of C and L, C being an idle wheel gearing with F and L. The motion of the wheel L is thus composed of three motions: (1) that which it has by reason of its revolution about B as a center, (2) that due to the revolution of the arm A about F, and (3) that due to its connection with F by means of the wheel C. We will consider the effect of these motions separately, and will begin with the simplest possible arrangement. In Fig. 1, let A be an arm which revolves about a center B, and carries a wheel L, which we will suppose to be fastened to it. If the arm be turned through one revolution, the wheel L will in effect revolve once about its own center. This will be clear by an examination of the successive positions shown in dotted lines, the revolution of the arm being in the direction of the arrow. For example, follow the motion of a point such as P; at 1 it is to the right of the center, at 2 below it, at 3 to the left, and at 4 above the center, finally returning to its first position on the right. We thus see that L has practically made one revolution about its own center, just as it would have if it had been fixed at B concentric with the arm. If L had not revolved by reason of the revolution of A, the point P would have remained horizontally to the right of the center during the revolution of A. This is, of course, the same motion as that of a crank-pin and crank, and will be still more clear if we remember that, if the pin did not in effect revolve about its own center, it would not turn in the brasses, and they could be dispensed with.

Now considering the second motion of L, that due to the revolution of the arm about F, refer to Fig. 2, and let the wheel F be fixed, or a dead wheel, concentric with the arm A. Let F and L have the same number of teeth. Then, while the arm revolves once in the direction indicated, L will revolve once in the same direction, the result being the same as if the arm had remained fixed, and F had been revolved once in the opposite direction. The final motion of L, while the arm revolves once, is therefore one revolution, as in Fig. 1, supposing F to be removed, and one revolution, as in Fig. 2, supposing F to be in place and fixed; or, while the arm revolves once, L revolves twice in the same direction.

Now, instead of F being fixed, let it revolve once in the direction of the dotted arrow. The effect of this will be to give one additional revolution to L, resulting in three revolutions of L to one of the arm. In order, then, to get at the resultant motion of the last wheel in epicyclic trains, we must consider the three independent motions separately: *first*, suppose the first wheel F, which is concentric with the arm, to be removed; *second*, suppose the first wheel to be in place and fixed; and *third*, suppose the arm to be fixed and the first wheel to revolve as intended. The final motion of L is the sum of these three motions.

For the sake of brevity we will designate revolution in the direction of the hands of a watch *ahead*, or +; and that in the opposite direction *backward*, or —. Thus expressed, the revolutions of L in Fig. 2, as we have just discussed it, will be:

(*a*.) + 1 due to the revolution of the arm,
+ 1 " " " " about F,
+ 1 " " " " of F.

\+ 3 revolutions of L to 1 of the arm.

As a further illustration assume that in Fig. 2, F has 40 teeth and L 30, then if F is a fixed wheel, L will revolve—

(*b*.) + 1 due to the revolution of the arm,
$+\frac{40}{30}$ " " " " about F,
0 " " " " of F.

\+ $\frac{7}{3}$ revolutions of L to 1 of the arm.

If F makes one revolution backward while the arm makes one ahead, we will have for L—

(*c*.) + 1 due to the revolution of the arm,
$+\frac{40}{30}$ " " " " about F,
$+\frac{40}{30}$ " " " " of F.

\+ $\frac{11}{3}$ revolutions of L to 1 of the arm.

If F makes one revolution ahead, or in the same direction as the arm, the result is to balance the effect of the revolution about F, and we have for L—

(*d*.) + 1 due to the revolution of the arm,
$+\frac{40}{30}$ " " " " about F,
$-\frac{40}{30}$ " " " " of F.

\+ 1 revolution of L to 1 of the arm,

or the same as in Fig. 1. Similarly, if we

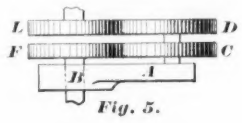


Fig. 5.

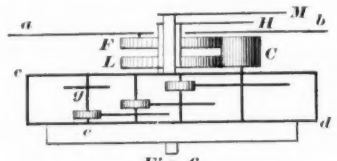


Fig. 6.

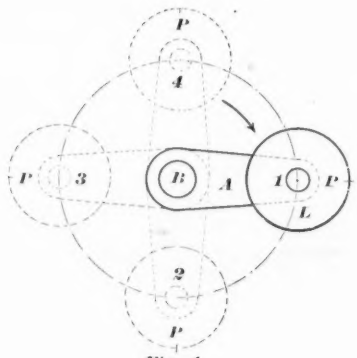


Fig. 1.

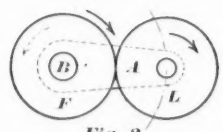


Fig. 2.

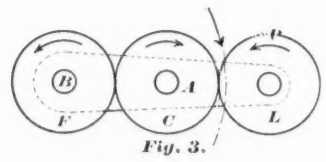


Fig. 3.

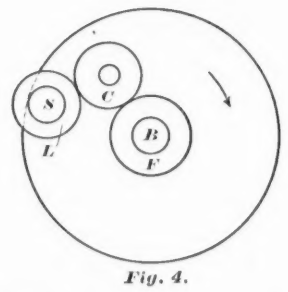


Fig. 4.

EPICYCLIC TRAINS.

take the conditions the same as (*c*) and let F have 30 teeth and L 40, we will have + $2\frac{1}{2}$ revolutions of L to one of the arm.

We will now consider the effect of introducing an idle wheel, as shown in Fig. 3. In the first place, let L equal F, and let F be a fixed wheel. The revolutions of L will be—

(*e*.) + 1 due to the revolution of the arm,
— 1 " " " " about F,
0 " " " " of F.

0 revolutions of L, or, in other words: a point P, which is, say, vertically over the center of L, will remain so throughout the revolution of the arm. If we assume the same condition as (*a*), the resulting revolutions of L will be:

(*f*.) + 1 due to the revolution of the arm,
— 1 " " " " about F,
— 1 " " " " of F.

— 1 revolution of L to 1 of the arm.

If we let F have 40 teeth and L 30, and let F be a dead wheel, we will have for L:

(*g*.) + 1 due to the revolution of the arm,
$-\frac{40}{30}$ " " " " about F,
0 " " " " of F.

$-\frac{1}{3}$ revolution of L to 1 of the arm.

Or, reversing the positions of the wheels, making F=30 and L=40, the revolutions of L will be:

(*h*.) + 1 due to the revolution of the arm,
$-\frac{30}{40}$ " " " " about F,
0 " " " " of F.

\+ $\frac{1}{4}$ revolution of L to 1 of the arm.

The arrangement shown at (*e*) is used in one form of rope-making machinery. The "arm" A, Fig. 3, is then the revolving frame which carries the bobbins on which the strands or wires have been wound. B is the center of this frame, and on it the wheel F is fixed. A small yoke or frame, which carries a bobbin, is fixed on the axis of L, there being as many of these wheels and bobbins as there are to be strands in the rope. Then if F and L have the same number of teeth as at (*e*), the axes of the bobbins always point in one direction, and the rope is laid up without twisting the separate strands. If L has a few less teeth than F, the strands will be given a slight twist, making the rope harder.

Arrangements such as Figs. 2 and 3 are applicable to boring bars having sliding heads. In such cases B would be the dead center on which the bar turns and on which the wheel F is fastened, being, therefore, a dead wheel. The wheel L is fastened to the end of the feed screw in the bar, as shown at S, in Fig. 4, which represents the end view of the bar. While this arrangement is an epicyclic train, such as we have discussed, the explanation of it is extremely simple, because the motion to be determined is that of the screw *S with regard to the bar*, not with regard to the lathe, or any stationary object.

As F is fixed, the effect on L of one revolution of the bar is the same as if the bar remained stationary and F revolved once. Thus, if F has 20 teeth and L 40, the screw S will make, in the bar, $\frac{20}{40} = \frac{1}{2}$ of a revolution, while the bar revolves once. And if the screw has four threads to the inch, the feed will be $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}''$. The effect of the idle wheel shown in Fig. 4 is simply to change the direction of the feed.

Another form of epicyclic train is that shown in Fig. 5, in which the last wheel is concentric with the arm and first wheel. This does not change the resultant motion of L in any way, but only makes a more convenient form for transmitting motion from L to other parts of the machine. If F and L have 40 and 30 teeth, while the wheels C and D are equal, we will have the same motion as at (*g*) and (*h*), supposing F to be a dead wheel. A recent and novel application of this form of train is to be found in the Waterbury watch, the principle of which is shown in Fig. 6. In this Fig., $a\ b$ is the face of the watch, and $c\ d$ the frame which carries the principal train of wheels, that from C to the balance wheel g. This frame turns about the center shown below it and the bearing in the face. It is driven by the spring e and carries the minute hand M, and hence revolves once each hour. Between the frame and the face is a pinion C, having 8 teeth, which is connected to the balance wheel g by the train of wheels shown, and itself gears with two wheels F and L, having respectively 44 and 48 teeth. F is fastened to the face, and so is a dead wheel, and L is fastened to the hour hand H by the tube, as shown. It remains to show that the hour hand will revolve once in 12 hours, as required by means of this connection. We have here an epicyclic train F, C, L, in which the first wheel is fixed. The revolutions of L during one revolution of the arm, as we have called it, or the frame $c\ d$, are therefore:

\+ 1 due to the revolution of the arm,
$-\frac{44}{48}$ " " " about F,
0 " " " of F.

$+\frac{4}{48} = +\frac{1}{12}$ revolution during one revolution of the arm or minute hand, which is, of course, as it should be. The remainder of the train of wheels in this watch does not differ in principle from that ordinarily employed, a peculiarity being, however, that the entire "works," held in the frame $c\ d$, revolve within the case every hour.

Another peculiar adaptation of epicyclic trains is for the production of very slow velocities, using a small number of wheels. For example, in Fig. 5, let the numbers of teeth on the several wheels be $F = 19$, $C = 20$, $D = 21$, and $L = 20$, and let F be a dead wheel. Working out this train as we have the others, it will be found that, while the arm A makes one revolution, the last wheel L will make but $\frac{1}{400}$ of a revolution. In the same way, if we take the number of teeth in order as above, as 27, 40, 37 and 25, the last wheel will make but one revolution, while the arm makes 1,000.

We have chosen examples in which the first wheel is a dead wheel, as these are the simplest and most common. By adjusting the speed of the first wheel, however, it becomes possible to transmit velocities by means of epicyclic trains, which would be practically impossible by ordinary means. As an illustration, suppose it is required to have one shaft make 641 revolutions to one of another. As 641 is a prime number, this ratio could not be transmitted *exactly* by ordinary gearing, on account of the large number of teeth required for a single wheel; but by means of an epicyclic train it can be readily accomplished. Of course, the necessity for such ratios as this rarely occurs in machinery.

A method of solving problems involving epicyclic trains, which will be more convenient for many than that which we have followed, is by means of a general formula. Let v = the value of the train of gears, or the product of the numbers of teeth on the drivers divided by the product of the numbers of teeth on the followers, which would be in Fig. 5, $\frac{F \times D}{C \times L}$. In case of pulleys, $v =$ the product of the diameters of the drivers divided by the product of the diameters of the followers. Let f, l and a represent the number of revolutions of the first wheel, last wheel, and arm respectively in the same time. Then, $v = \frac{l - a}{f - a}$. If one direction is represented as +, the other will be represented as —. If the last wheel is to revolve in the same direction as the first, supposing the arm to be fixed, v is +, and if in the opposite direction, it is —. For example, take the data as at (*b*), then,

$$v = -\frac{40}{30} = \frac{l - a}{0 - a}, \text{ whence } l = \tfrac{7}{3}\, a.$$

Again, let it be required that L shall make one revolution to 1,000 of A (Fig. 5).

$$v = \frac{1 - 1{,}000}{0 - 1{,}000} = +\frac{999}{1{,}000} = \frac{27 \times 37}{40 \times 25} = \frac{F \times D}{C \times L}$$

One of New Jersey's Relics Going.

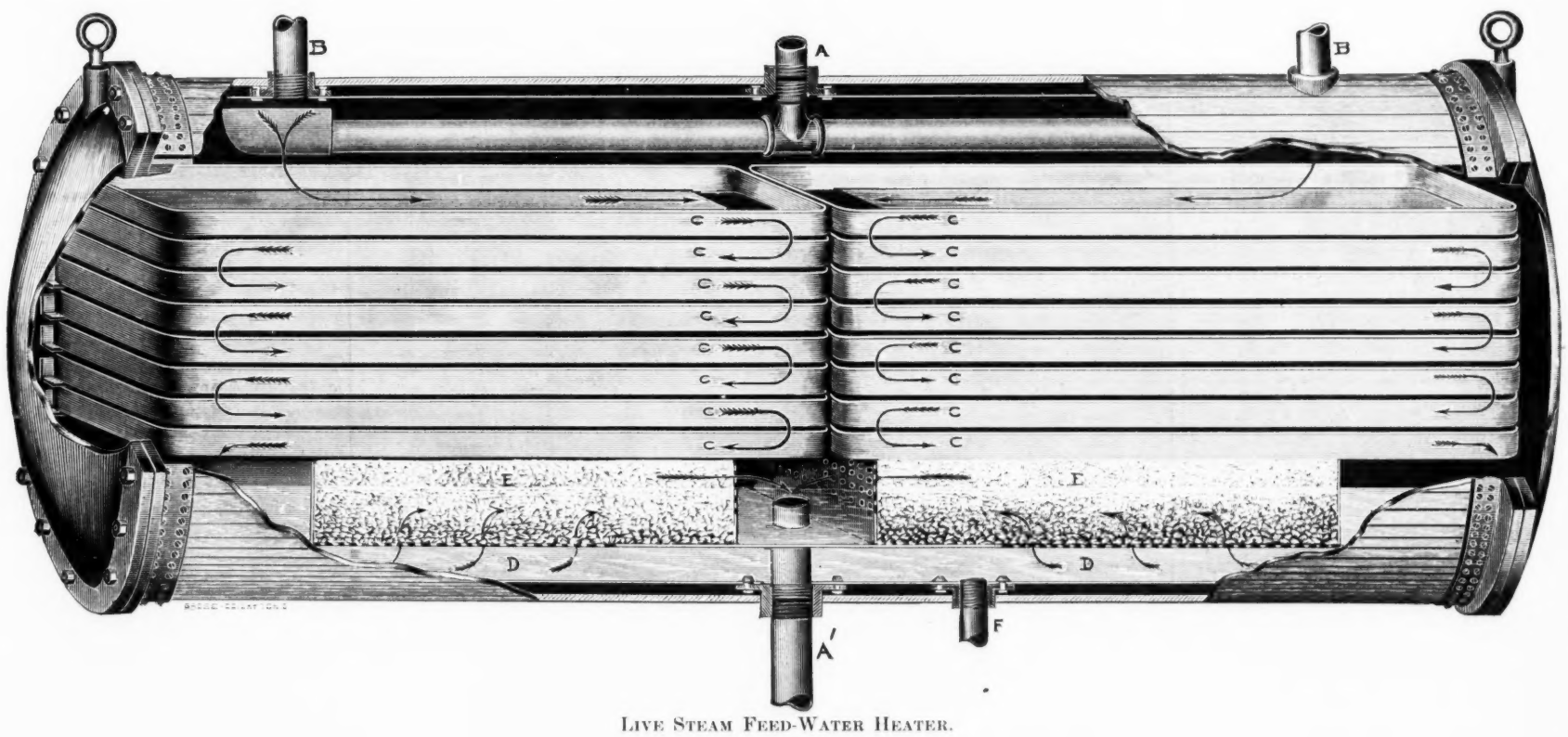
The old blast furnace at the Oxford Iron Works, Oxford, N. J., is being torn down to give way to modern improvements. The furnace is one of the oldest relics in the county, and was erected over a century ago. It is the oldest stack in New Jersey, and rendered valuable service in manufacturing ammunition for the revolutionary war.—*N. Y. Mail and Express.*

Live Steam Feed-Water Heater.

We give on this page an engraving showing the construction of a live steam feed-water purifier, made by the Stilwell & Bierce Manufacturing Co., Dayton, Ohio.

It is intended for use either where it is not practicable to use an exhaust heater, or where the character of the impurities contained in the water are such that they cannot be removed by that alone; in which case it is to be used preferably in connection with the exhaust heater through which the water passes before reaching this one. The water enters at *A* and flows through the T to the ends of the branch pipe, which are perforated and discharge the water in the form of spray into the outer ends of the two upper pans. It then flows from pan to pan in the direction indicated by the arrows, and is always in a thin sheet and exposed to full boiler pressure and heat, live steam being admitted at *B. B.* The water, after flowing from the lower pans, falls into the settling chamber *D*, where the non-crystallized impurities deposit in the form of slush or mud, and can then be blown off through the pipe *F*. From the settling chamber the water rises through perforations to the filter *E*, when it passes through coke or other filtering material to the pure water chamber, and to the boiler through pipe *a*.

The water, in passing over the bottoms of the pans in thin sheets subjected to the action of live steam directly from the boiler, deposits its impurities upon the pans in the form of scale, which can easily be removed. The heads are fastened on by cap bolts, and, when removed, the pans can be drawn out, cleaned, and replaced very easily. The shell of the heater is of steel, and the heater is made to stand any desired pressure, and to fill any required conditions.



LIVE STEAM FEED-WATER HEATER.

LETTERS FROM PRACTICAL MEN.

Boring a Cylinder Oval.

Editor American Machinist:

I owe many thanks to Mr. Miller for valuable information on the subject of boring cylinders, and also for the formula that he gives, and which I have used in finding the effects of various settings of cylinders in boring.

No mechanic, I think, would set his tail stock over in the hopes of securing any advantage in doing so. If this is true, the question narrows down to this: What would be the effects of any set over that was overlooked, or any wear that would make one center out of level with the other? Mr. Miller is undoubtedly right in speaking of the shape of the hole caused by the centers being out of line, but I think it would be hard for him to prove that any given hole was out of line because of this; by measuring it, for instance, with a 4 foot bar (about what we use for a 12″ stroke cylinder), boring a 10″ hole, a variation of $\frac{1}{8}$″ in alignment, would make a variation of $\frac{84}{1000000}$ of an inch in diameter. Few cylinders of this diameter are true to $\frac{1}{1000}$ of an inch, yet to cause such a variation we must be out of line $\frac{1}{32}$″, or nearly $\frac{3}{4}$ of an inch.

I asked an experienced man what he called a practical true cylinder of 10″ diameter. He said it must be within $\frac{1}{100}$ of being round.

To get this variation, we must get the centers $2\frac{2}{14}$″ out of line, and for the 30° variation that Mr. Miller gives in illustrating the principle, we need a variation of over 2 feet.

Now, Mr. Editor, I think that any variation that cannot be measured without an expert is practically no variation, and is no excuse for poor work. I have worked on very poor lathes, but don't think I ever worked on one that would bore bad enough to make a measurable difference unless by a deliberate attempt to get a poor job, as neither wearing down of the spindle or bearings, or mistaking the scriber or chisel, or center punch marks in setting the tail stock, would give enough variation.

Mr. Miller says it is hard for a goodly number of lathe hands to understand why it is that, when turning a shaft with the center set over, the work will be round, but tapering, while boring a cylinder, with a bar with fixed cutter, the bore will be neither round or tapering with the lathe set over in the same manner. Is Mr. Miller sure the taper turned would be round? I think not; and also that the variation might be enough to affect the fit of the pin if the taper was great.

One of your contributors explained how it was impossible to get a true thread by setting the center over, on account of one-half revolution of the lathe driving the work more than half-way round, and the other half not driving it half-way round. If this would cause a drunken thread, it would also cause a drunken feed. Suppose, for instance, we turn up a piece with a taper of 1″ in 4″, and after turning set the lathe straight, and cut the piece in two in the center, would the ends be round or some other shape? If, before cutting the piece, we were to drive it into a true reamed hole, would it show an even bearing all round?

I know it would be hard to prove by calipering that the pin was or was not round, but if it was round it should fit, and I know such pins bear hard in lines, and no amount of turning and trying in different parts of the hole will find a place that is a perfect fit. Of course with a slight taper this variation would not show. How is the Morse twist drill taper put on, and other such work done, with a taper attachment or setting over the center? Perhaps, if I am wrong in my reasons for taper pins fitting as they do, some one can give better reasons.

To return to boring cylinders, will Mr. Miller give me some rule to find out how much a cylinder will alter in shape by taking out a cut or two, and afterward facing it, and turning off the flanges? Or how much one can spring a cylinder out of round by an injudicious use of bolts, etc., in fastening it on the lathe? Or what effect planing and drilling, and putting in bolts may have? Or whether the steam heat is enough to cause any change in shape, by causing certain parts, that receive more heat, to expand more than other parts?

When I spoke of the boring bar run true on the centers, I did not mean the outside of the bar, but the center line, or the point of the tool.

As hardly anything a machinist turns in a lathe is really round, so likely his lathe centers are not either, or the centers in the end of his bar, and the result of "now tight" and "now loose," every revolution, cannot be very gratifying.

A man bored a hole in the end of an engine bed while that end ran in the steady rest; the hole was $\frac{1}{16}$ out of center. The man gravely assured me that the lathe centers must have been out of line, or else in his hurry he did not get his steady rest set true with the center line of his centers, for either one would make the hole out of center, though he bored the hole with a tool, and afterward ran a reamer through.

Ninety-nine out of every one hundred poor jobs are caused by lack of attention to details, and an intelligent observation, while the other one is as likely to be caused by preventable causes within reach of the owners of the shop as to any causes that are too hard for the average mechanic to see and understand.

W. O. PLATT.

In the first place, as Mr. Platt's communication, published in the issue of Jan. 17, shows, he denied that the effect of setting a bar out of line would be to bore an elliptical hole. As I had often heard it denied before, I thought it worth while to attempt a demonstration of the fact. My article was devoted to that purpose, and to that only. Mr. Platt now acknowledges that, but brings up the fact that an accidental displacement would have a very small effect, which is true enough. But no particular amount of displacement was specified, either by the original questioner or by Mr. Platt, and I took an excessive amount simply because I thought I should be able to make the principle more easily understood by doing so. Though the angles specified could not be attained upon a lathe without special bearings for the bar, yet a way could be found for getting such angles, if it were considered desirable to bore ovals in that way.

It will be remembered that Mr. Platt himself first mentioned taper pins, and seemed to argue that, because they were round—or, at least, not oval—therefore the cylinder would be round. Now he says they are not round. They are not usually as near round as ordinary cylindrical work, but that is due principally to the fact that the centers do not fit, and that the ends of the pin are not exactly true. When a straight piece of work is turned, the ends may be a little out of true without affecting the truth of the work much, if any, and the same is true if taper work is turned with the taper attachment or compound rest; but if the center is set over to turn taper, then it is of prime importance that the ends of the work should be just as true as possible. And I think it is because of the fact that the ends are not usually very true that taper pins turned in that way are not round.

Any one can satisfy himself on this point by centering a piece, leaving the ends purposely out of true, and then putting it in the lathe with the center set over. It will be found quite tight during one part of its revolution, and so loose as to admit of considerable endwise movement during another part. I have found taper work turned by the taper attachment to be fully as true as straight work turned in the same lathe, and I feel quite sure that this is not due to a sober feed, but to the fact that the centers are kept in line. It would scarcely be expected of me to deny that, with the center set over, a thread cut would be drunken, since the article to which Mr. Platt evidently refers, and which was published in the issue of March 31, 1888, in which a demonstration of that fact is attempted, was written by myself; but I do deny that a feed, even though very drunken from that cause, could affect the truth of the work in the least. It may help Mr. Platt to perceive this by considering the case of a pair of centers mounted upon a shaper, as is sometimes done in fluting taps, etc. If one center be elevated above the other, and a piece of steel placed upon them and revolved slightly at each stroke of the tool, a taper pin will be produced, and it could be made as round and true as if turned in the lathe, yet this would be the drunken feed carried to the greatest possible extreme.

F. J. M.

Steam Pipe Arrangements—Expansion Joints.

Editor American Machinist:

A recent article from W. H. Booth, on "Steam Pipe Arrangement," includes some points that I can certify are correctly stated. He says that "Further application of the

principle of inertia will teach that, when a steam pipe leaves a boiler, it should be as large as conveniently practicable, so as to reduce the velocity of inrush of the steam, and prevent it from carrying in water." A case in point: Six 48 inch by 20 feet high pressure two-flue boilers were fitted with single domes, 24 inches diam. and 30 inches high. They were connected by semi-circular or curved 6" copper pipes. Water was often carried to the engine in large and dangerous volumes, and we had to apply automatic cylinder waste cocks of large size. The arrangement of connections on domes was changed, as the time of re-fitting came round. The copper pipes were taken off, and boiler plate pipe sections, 12" diameter, placed transversely between the drums. There was no further trouble from water, no matter if it passed its regular height in the boiler, or if the engine labored hard.

Another point: I have seen much trouble from leaky joints on boilers, where the nozzles of a long steam drum were of boiler plate and riveted directly to the shell. But when cast-iron branches or nozzles were riveted to drum (6, 8, or 10 in a row, representing as many boilers,) and the same pattern of nozzle riveted on the boilers, such attachments on drum and boilers having the rivets driven from the inside, and inside caulking also—the joint on the connecting flanges being copper grooved wire (annealed), or thin sheet asbestos—there were no leaky joints to look after.

I would like to hear from the readers of the American Machinist as to the best form of expansion joints for steam pipes of large and small sizes. There is great difference in opinion amongst engineers as to the value of expansion joints, and I think a little discussion of the subject would be of considerable practical value. D. W. L.

"Heavy vs. Light Reciprocating Parts of Steam Engines."

Editor American Machinist:

The article under the above title, appearing in the American Machinist of January 24th, excites my admiration for one thing, at least, and that is, its audacity. How any thinking, practical mechanic, such as your correspondents are supposed to be, can boldly proclaim, in opposition to the very best engineers of the day, as well as against the actual practical demonstrations of years of steady trial, that the teachings of Charles T. Porter in relation to the proper weights of reciprocating parts for steam engines are all wrong, and that the proper way is simply to make these parts as light as possible, passeth my understanding.

For me to attempt to defend Mr. Porter's teachings would be equally audacious, and to attempt a better proof than his own logic would appear like trying to prove an axiom; a truth self-evident; therefore I will make no such attempt. An experience, which has covered a great number and variety of engines, has proven some things, to me, in the most forcible and conclusive manner, and ofttimes against preconceived ideas of my own. Among them are the following:

1st. The even distribution of pressure upon the crank-pin *has everything to do with smooth running.*

2d. That parts too light will prevent this desirable evenness of pressure, and are absolutely certain, sooner or later, to cause the crank-pin to wear flat on one side (the outside).

3d. That parts too heavy have the same fault and produce the same effect, except that the wear of the pin will be on the opposite, or inner half.

These effects, if excessive, will also show in the same manner on the main journal, except when modified by the effect of the counterbalance.

4th. Excessively heavy reciprocating parts will invariably cause quiet running until the pin and main journal have worn out of round, when heating sets up and thumping commences. Even then it will be of a much milder character than the pounding with light reciprocating weights. This peculiarity is easily explained. The slack in crank-pin brasses, when taken up before reaching the center, as is apt to be the case with light parts, causes a thump that is sudden and vicious, because it results from the meeting of the pin traveling in one direction and the brasses traveling in the opposite direction; while with very heavy parts, this taking up of the slack occurs after passing the center, the thump, if audible at all, being caused by the brasses overtaking the pin, both going in the same direction. In one case we get the sum of two velocities, in the other the difference.

Finally, when the reciprocating weights are such as to wear the pin true and round, and it runs cool and quiet, as the natural result of such wearing, I have invariably found them to approximate to the weights called for by Mr. Porter's rules. In short, there is a correct weight for the reciprocating parts of engines that will give the best results, and that weight will vary from light to heavy, according to the various conditions of speed, pressure and load.

To make a rule, disregarding all conditions of running, that the reciprocating parts should be made, simply as light as possible, is manifestly a mistake.

Mr. Harrison makes a number of statements that will surprise many of your readers:

1st. That inequality of pressure on crank-pin is desirable and necessary.

2d. That engines built after Mr. Porter's rules are inclined to hot pins and thumping centers.

3d. That heavy reciprocating parts always give trouble.

4th. That compression is necessarily essential to the proper arrest of the reciprocating parts.

5th. That no foundation can resist the effects of horizontal swaying caused by heavy parts.

Taking the first three statements in a lump, they are controverted by the admirable performance of thousands of first-class engines, built during the last twenty years—a class of engines, the equal of which was never before known, and which, though built by more than a dozen different engineers, are in almost every instance designedly built after Mr. Porter's teachings and practice, regarding the influence of the weight of the reciprocating parts. If there is any one feature that is especially characteristic of the modern high-speed engine, it is its smooth running qualities.

As to the 4th statement. If Mr. Harrison will sometime note the smooth running of some Buckeye, Porter-Allen, or other good engine, that has small clearance, and, therefore, very abrupt compression, and then note the equally smooth running of some good, single-valve engine, with more clearance and much greater compression, he will conclude that a wide difference in compression makes no perceptible difference in knocking at the centers. Compression is, in fact, almost wholly a matter of economy of steam.

As to the statement concerning foundations: hundreds of horizontal engines can be seen at work in this country, so effectually held, by ordinary foundations, that they will not shake a nickel piece off, when balanced on its edge, upon some smooth and polished surface, such as the jacket of the cylinder, the engines being at full speed and load, and having the heavy reciprocating parts, so readily condemned. One can also find many of these engines that Mr. H. declares it is impossible to successfully hold, that are regularly run at full speed before leaving the shops, for the purpose of testing the balancing, without being bolted down even; simply set loosely on top of the testing block.

As to the matter of obtaining perfection of balance, both horizontally and vertically, in the same engine, we all know it cannot be done. This is fully explained by Mr. Porter. It can, however, be secured to a degree that leaves but little to desire in ordinary practice.

The conditions that obtain with locomotive performance are so entirely different from those of the stationary engine, that comparisons of the two are of but little value in an argument of this kind. This fact has been learned, however, in connection with locomotives: they must be balanced approximately to Mr. Porter's rules in a horizontal direction, in order to secure steadiness in a horizontal plane, and to guard against jerking effect on the train behind them. This latter effect caused more trouble in early days, before this matter was commonly understood, than has ever arisen from want of balance in a vertical direction. The reciprocating parts of locomotives are necessarily made as light as possible, on account of the high number of revolutions made, when at full speed.

This reminds me of a question I would like to ask. Why do the opponents of high speeds say it is so difficult a matter to make stationary engines run well at high speeds, when they ride every day behind locomotives that run at speeds that would make the so-called high-speed stationary engine blush with shame? They do it, too, without any of this destructive heating, pounding, etc., charged as inevitable against high-speed stationary engines, which have all the advantages in the way of good foundations, heavy castings, counter-balancing, accessibility, lubrication and cleanliness, whereas the locomotive goes swaying between the rails, and over joints and frogs, across dusty and muddy crossings, raising dirt and grit that would be considered simple destruction to stationary engines.

Just think a minute. We hardly notice such a common thing as an 18" or 20" locomotive engine, of 22" or 24" stroke, running from 200 to 280 revolutions a minute, under the adverse circumstances cited above.

Why, then, let me ask, is it so difficult to make a stationary engine, of locomotive size, to run say 160 to 180 revolutions per minute, or a 20" stroke engine to run 225 to 240, or a 16" stroke up to 280—speeds that are certainly slow as compared with locomotive performance?

The answer is easy. It simply *is not difficult to do.* It is being done every day, and has been done regularly for years. The reason why it is possible, and even easy, to do such things, is that, understanding nature's laws, the effects of inertia, momentum, and the general phenomena that are manifested in steam engines in motion, and intelligently designing the engines in strict accordance thereto, must result in a natural, harmonious machine, suited to the conditions intended for.

Once completed, such an engine, like a man or a horse, has a certain *natural* gait, at which it will give the least trouble, endure the longest wear, and render the greatest service. This natural pace or gait varies in different engines, as in different animals, being quick in some and slow in others. But, whatever the natural gait is, it must be recognized and respected, if trouble is to be avoided. To compel the fast to a slow gait is just as severe as to compel the slow to a fast gait, being unnatural in either case.

Dunkirk, N. Y. F. B. Rice.

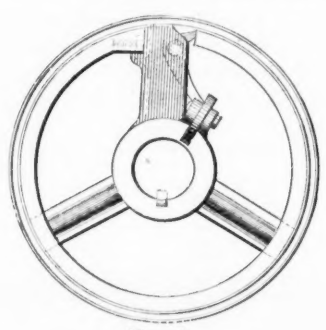


Fig. 1.

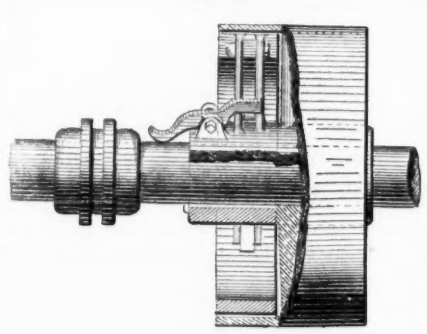


Fig. 2.

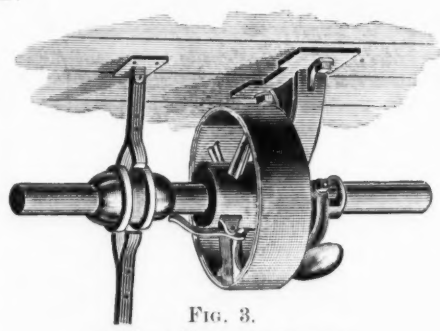


Fig. 3.

A New Friction Clutch.

Professor Torrey's Side of the Question.

Editor American Machinist:

I am very sorry the "Prof." part of my name has led Mr. Harrison to take for granted, as he apparently does, such gross ignorance on my part, of the actual conditions under which engines run. I am not so much surprised that he should have misunderstood the purpose of my explanation of the action of inertia in bringing about uniform effort on the crank, and it is not surprising that he should infer that I think the reciprocating parts should be made heavy, and thus develop the necessary inertia, although that is not necessarily the case; but his remarks on marine and locomotive engines made me wince.

If Mr. Harrison, or any others who may be exercised in mind, for fear I may teach false principles and impracticable schemes, will wait till my work in this line is done, I will cheerfully await criticisms.

With this brief explanation, I will leave the matter, as most of the points in Mr. Harrison's note will be met in future papers.

J. Torrey.

A New Friction Clutch.

We illustrate on this page a new friction clutch, which has been brought out by Jones & Rogers, Cincinnati, Ohio, and by them named the "Standard."

Fig. 1 is an end view of the expansion ring and spider for holding it, and the levers for expanding the ring to make the grip between it and the rim of the pulley.

Fig. 2 is a side view of the same, partly in section, and Fig. 3 shows it as it appears in use.

The ring hangs loosely upon three points of the spider, and for that reason, when expanded, is free to come into full and close contact all round the rim; thus, all uneven wear is avoided, and the pulley is never thrown out of balance, as it would be if the ring were held at a fixed distance from the center at any point.

A set screw and lock nut is provided at one end of the expansion ring for taking up any wear which may occur, though this wear, owing to the large friction surfaces, and the fact that they are at the greatest possible distance from the center, is reduced to the minimum.

Being of few parts, and these made very strong and durable, the clutch is well adapted to hard and rough usage if required. It is made in such sizes and proportions as may be required by the makers, whose address is given above.

Captain Stone on Quick-firing Gun Defense.

The importance of this paper, which has been briefly reported in the *Times* and daily papers, is shown by the fact that Lord Wolseley took the chair, while Sir Gerald Graham, Lord Charles Beresford, Mr. Nordenfelt, General Nicholson and others took part in the discussion that followed. Captain Stone, R. A., dealt with the application of the pieces delivering shells at the recently increased rates, as distinguished from the hail of solid projectiles poured in by the lighter machine guns. He discussed the application of this rapid shell fire in the defense of the Thames and Medway, as well as

Plymouth and Portsmouth and other ports, dwelling on the principle of dispersing guns in concealed positions. He then passed on to siege operations, and to lines of defense such as have been proposed for London. He pointed out the great disadvantage to which defense is subjected when it depends on obsolete guns, which are passed over from our first line of works and our fleet. He quoted the fact that the Russian losses in Sebastopol, in the fire which immediately preceded its fall, were 7,561 men, as compared with 839 of the British, while eighty-nine guns were dismounted. This he attributed partly to the inferior character of the Russian guns—the number of rounds they fired being nearly half that of the British ordnance. Captain Stone, however, especially dwelt on the fact that the question he brought forward was not one of the abstract relative power of gun and armor, so much as the scientific development of our fire. In the discussion that followed General Sir Gerald Graham supported the lecturer's view that the defense of coaling stations should be undertaken by land forces, and that the navy should be wholly free to perform the naval operations which would be necessary in war. Lord Charles Beresford opposed this view, but dwelt on the need for larger supplies of quick-firing guns. Lord Wolseley urged that ships in defense were mere floating batteries, and dwelt on the importance of developing systematic coast defense, pointing out that the development of high explosives had rendered many of our fortifications useless.—*The Engineer* (London).

Hand Drilling Machine.

We illustrate herewith a small drilling machine, made to be clamped upon a bench, and to be driven by hand. The spindle is hollow and is provided with a split chuck which will take drills from No. 48 down to No. 80. The distance from spindle to table can be varied from 6″ down, the adjustment being easily made either by moving the spindle frame, the table bracket, or by moving the clamp nut under the table. There is a friction pulley which is intended for the heavier work, but for very light work the catgut should run directly over the driving pulley. By placing a spiral spring around table spindle it can be made to feed automatically. The cut is about one-fifth actual size. The maker is C. G. Harstrom, Peekskill, N. Y.

Preliminary Trial Trip of the Hoboken Ferry Boat "Bergen."

On February 6th a trial trip was made with the new Hoboken ferry boat "Bergen." A description of this boat and illustrations of her triple expansion engines were given in our issue of November 24th, 1887.

This trial trip was simply a preliminary one, and the engines were not worked near to their full capacity. The run was made from the ferry company's pier in Hoboken to some distance beyond Fort Lee. The boilers and engines are built and arranged for a steam pressure of 160 pounds; on this trial trip only 100 pounds' steam pressure was carried, yet with this pressure a speed of 15 miles per hour was maintained. It will be remembered that this boat has a propeller at each end, instead of the usual side wheels near the center of the boat. The results obtained were excellent; the speed, ease of maneuvering and backing exceeded the best expectation of her designers. The official trial trip will soon take place; no date for it has at present been fixed.

The Rhode Island Commissioner of Industrial Statistics shows that about 4,000 children are employed in that State in violation of the law. These children are mostly employed in cotton and woolen mills. Twelve per cent. of the children in the State between the ages of 10 and 14 do not attend school.

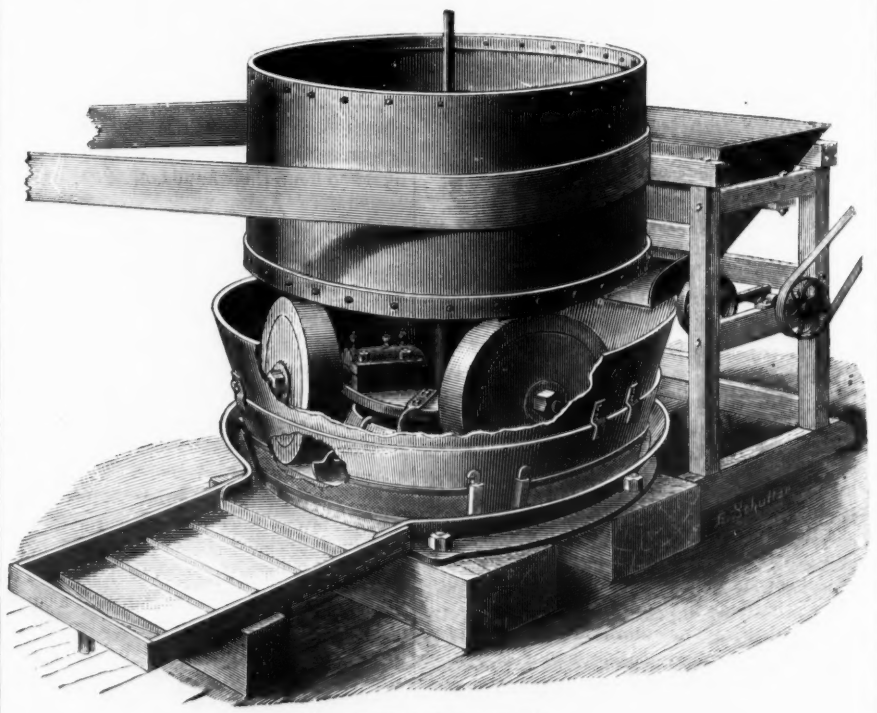
The consumption of hemp is said to have increased 25 per cent. in the United States during the past year.

The Bryan Roller Mill for Gold and Silver Ores.

The engraving which we present with this represents a mill for crushing silver and gold-bearing ores, now being manufactured by the Risdon Iron Works, San Francisco, Cal. This mill is said to be attracting much attention from practical mining and mill men throughout the mining world. It is very simple in construction, and it is claimed possesses many advantages over the stamp mill.

HAND DRILLING MACHINE.

The engraving clearly shows the plan and construction of the mill. It consists of three steel-tired rollers, which run over steel dies in an annular mortar. An iron tank or drum, around which the driving belt passes, bears on the face of the rollers and increases their crushing force. The rollers in a four-foot mill are 31 inches in diameter, 6 inches wide, and weigh 1,200 pounds each. They are provided with steel tires, 3 inches thick. The rollers in a five-foot mill are 44 inches in diameter, 9 inches wide, and weigh 3,650 pounds each. The tires are of steel, four inches thick.



THE BRYAN ROLLER MILL.

The axles are fixed solid in the rollers and are journaled on an annular plate, which rotates loosely around the solid center post; all the bearings are thoroughly lubricated by oil channels, so arranged as to prevent oil or grease from entering the mortar. The solid center post is made fast in the mortar; it enters the bearing plate of the drum, which, with the rollers, rotates round the post as a common center.

An important adjunct to this mill is the device for keeping the rollers clean from pulp. It consists of an adjustable spring and scraper, shown very clearly in the engraving, which follows each roller in its rotation. The spring is set to the die and its tension is readily adjusted. The direct purpose of the scraper is to keep the face of the die, and the roller also, clean from pulp, which otherwise would collect and adhere to the roller and reduce its crushing force. The scrapers serve also to discharge the pulp, and to distribute and equalize on the dies the ore received from the feeder.

The mortar is provided with screen openings all the way around, thereby giving ample surface for discharge. The chute for carrying off the pulp extends all around the mortar to the spout over the apron.

In the operation of the mill the pulp runs round the mortar, next to the screens, in a rapid current of not less than 300 feet per minute; but toward the center, inside of the rollers, the movement of the pulp is much slower, and as the gold is liberated from the matrix it falls to the eddy side of the current, and in practice is found amalgamated in mass around the cone in the center of the mortar. By this action the free gold is not subjected to the continuous grinding of the rollers in the mass of pulp, as is the case with stamps, and nearly all the gold contained in the ore—fully 70 per cent.—is retained in the mortar. The ore does not slime, and the sand and pyrites are left of uniform size, and in the best condition for concentrating. The "clean-up" of the mill, owing to its simple arrangement, is done with the greatest ease.

We are assured the mill is made of the best quality of iron and specially selected steel, and is thoroughly finished in all its parts. The mortar, with the chute and spout, is generally cast in one solid piece, but for transportation by packing in the mountains the mortar is specially cast in sections weighing 300 pounds.

This mill is adapted for any gold or silver mine, large or small. To a party of miners having little means, and owning a small mine, it would appear to be particularly valuable, for at a slight expense they can get the metal from their ore and "pay as they go."

A set of wearing parts for the five-foot mill weigh 5,150 pounds, and are guaranteed to crush from 6,000 to 8,000 tons of ore. The wearing parts for the four-foot mill weigh 2,600 pounds, and will crush from 1,500 to 2,000 tons.

Although comparatively new, this mill is already in use by some of the most prominent mining men in the country, and they give excellent accounts of its operation.

About the best evidence of improvement in the iron trades in England is the fact that the wages of iron workers have been advanced three times within a few months. The matter of wages has been submitted to arbitration, and while the men have not got all they asked for, they have got substantial advances.

Cornelius H. De Lamater.

We deeply regret to hear of the decease of Cornelius H. De Lamater, the head of the firm of C. H. De Lamater & Co., of the De Lamater Iron Works, New York City. This sad event occurred at his residence in this city, on the 7th inst. He was born at Rhinebeck, N. Y., August 30, 1821, and received his education in the schools of that place. At the age of fourteen he was obliged to begin life for himself. He started as an office boy in a hardware store in this city; at the age of twenty-one he became a clerk in the Phœnix Iron Works at Canal and West streets. Three years later the firm dissolved and Mr. De Lamater and Mr. Hogg formed a partnership, and continued the business until 1850, when they moved up-town to the present situation of the De Lamater Iron Works foot of West 13th street. A few years later Mr. Hogg retired, and Mr. De Lamater continued in business alone. He soon became known among the engineering profession; through close attention to business and uprightness in all his dealings he made many friends and established a successful business. He did more work for Capt. Ericsson than any one else engaged in the line of engineering; he built the first hot-air engine; he also built the hot-air ship, which at the time was considered a great feat in the line of marine engineering. He built at his expense for Capt. Ericsson the submarine gunboat "Destroyer"; and is also known as the maker of some of the first propellers in this country, and continued to make during his active career many propellers of different forms. During the war he did a great deal of work for the government, among which was the steamer "Dictator," and the engines for the first monitor; besides considerable repairing on other vessels. In 1870 he contracted to build for the Spanish government thirty gunboats, each 105 feet long, 22 feet beam, and 8 feet hold; the speed of these boats was 10 knots, and each carried a 100-pound Parrott rifle. These boats he finished in four months after the contract was made. The total number of marine engines built in the De Lamater Iron Works is 251, of which the last one was finished a few months ago. Mr. De Lamater also brought out Capt. Ericsson's new invention of a very convenient pumping machine for house service, of which between four and five thousand are now in use in the City of New York for pumping water in tanks on the housetops. Mr. De Lamater was identified with and held considerable stock in a number of steamship companies, and was a good customer and admirer of the late John Roach.

The Shoe and Leather Reporter Annual for 1889 is a handsomely bound volume of nearly 550 pages. It gives a list of boot and shoe dealers and manufacturers in the United States and foreign countries, also the names of manufacturers of and dealers in leather and findings. There is much other matter in the book that will be valuable to those in the trade. The book is published by the *Shoe and Leather Reporter*, New York.

The trial of the second steel gun, which so far appears to have been satisfactory, only makes the matter of the use of cast-steel guns more puzzling to the experts. Had this gun failed, as the first one did, then such guns would probably have been condemned; but if it proves a success, then it must be concluded that there is reason for further efforts.

Geo. M. S. Horton, Tribune Building, New York, has prepared for John Finzer & Bro. a handsome lithograph portrait of Grand Chief Arthur, of the Brotherhood of Locomotive Engineers. It is an excellent likeness, and does credit to the artist.

A bill before the New Jersey legislature makes it unlawful for employers to demand a pledge of their men not to join a labor organization. The less law there is about such things the better.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
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Publishers' Agents, New York.
The International News Company,
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NEW YORK, FEBRUARY 14, 1889.

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Some Further Points About Steel.

Another point regarding the use of steel in machine shops, which, for lack of space, we did not mention last week, is the notion—fast giving way in the light of experience, but still far too prevalent—that, when the best steel obtainable is wanted, it must be imported, because the best steel cannot be made in this country. Of course, there has been a time when there was good reason for this, but that reason disappeared years ago, and the chief cause of the persistence of the notion is one which is not as generally understood among steel users as it ought to be.

Steel makers in this country are obliged to make steel of various qualities, to suit the different requirements of purchasers. Not every consumer of steel will pay the price which must be charged for good steel, and, consequently, must be supplied with something cheaper; the result being that the market is supplied with many different qualities of steel, with a very wide difference in price between the poorest and the best. Now steel makers in England and on the continent do the very same thing to supply their various home markets, but it does not pay to import the cheaper grades of steel into this country, while it does pay to import the better grades.

For this reason an American buying imported steel must, of necessity, buy a good quality, simply because he can get no other, while that which he buys of home manufacture may be of any quality which he chooses to pay for, and is usually not by any means the best quality. It is obviously unfair to make comparisons between the cheapest qualities of American steel and the best qualities of imported steel, and then to conclude that Americans do not make steel equal to the imported; yet this very thing is being done continually.

We do not believe that any better or finer steel is made anywhere than is made in this country; but, like most other first class articles, it is necessarily high in cost, an important factor in the cost of its production being the fact that, because no iron has yet been produced here of which it can be made, it must be made of the finest quality of Swedish iron, which is imported at a high cost, part of which is an import duty.

A fact which illustrates the strength of prejudice is that a good deal of this steel is used by consumers, to whom it is giving perfect satisfaction, they thinking that it is English, and that nothing else will answer their purpose. They are not deceived by false branding, for no branding is done by either English or American makers on the small rods to which we allude.

Then, in regard to the self-hardening steel, which is coming more generally into use in our shops, there is quite a good deal of misunderstanding. American steel makers do not make Mushett steel, of course, for the same reason that they do not make any other English steel; but they do make a self-hardening steel which is at least quite equal to it. The idea is quite prevalent that these self-hardening steels will cut hard material which no other steel will cut. This is a mistake. Steel can be had of American manufacture, which hardens in the ordinary way, and will cut chilled iron or other obdurate metals, so hard that neither Mushett's nor any other self-hardening steel will cut them at all.

Finally, if you are a steel user, don't conclude that you, or your tool dresser, know all there is to be found out about working and using steel. Steel makers don't pretend to know that much, but they do have better and more extended opportunities for finding out things about it than any one else can possibly have, and if anything goes wrong with the steel you are using it will pay you to consult the maker, giving him all the facts in connection with the matter, and to give his suggestions a full and fair trial.

What May be Done with an Invention.

A correspondent writes us as follows:

Being a constant reader of your valuable paper, I come across a good deal that is instructive, and for which I have been thankful. I notice in a recent issue a short article on "Business and Mechanical Ability," and it seems to me that there are many more besides myself that would like to know something more about the business part. For example, I have an invention relating to a lathe, that, I am positive, would "take," if in the hands of a proper business party. But if I were to try to patent it, from all I can learn I would lose it during the time it was going through the Patent Office.

Suppose a working mechanic to get a patent, with no means to put it into use. How does he set about putting it in the market?

Our correspondent is troubled just as a great many mechanics are troubled. Popularly, every man in this country is equal before the law, but as a matter of fact, pecuniary means to back up his rights or to smooth over his wrongs goes a long way. Examples of this fact are particularly prominent in relation to patents.

But there is little fear of losing a patent outright, that is, of losing it so there is not in the courts a fighting chance. A patent, if of anything important, gives, at the present time, a certain standing in the courts, and this is about all it does. If there is plenty of money behind it, it may be let alone; if there are no means behind it, it is likely to be infringed.

There is not much fear of losing an invention while it is going through the Patent Office. The filing of the necessary papers is sufficient evidence of property right, unless some one can claim and establish priority. After the patent issues, a man of small means had generally better make arrangements with some one in the line of manufacture to which his patent relates.

In the instance of something connected with lathes, it is fortunate that there are so many honest manufacturers who would deal fairly in the matter. But the invention must be a valuable one, or the builders of lathes will not look at it. This is especially true if the invention calls for a radical change in construction.

The best advice we can give our correspondent is to first submit his invention to some disinterested party. The drawings, properly witnessed, will be very good evidence, but still it is better to show it to an honest man. We advise this course, because any man is likely to get an exalted idea of his own invention. If his friend, or friends, think well of it, he can apply for a patent, and afterwards make terms with manufacturers. It requires money to work a patent, and quite often to defend it; but if a responsible manufacturer takes hold of it, thieves are more likely to keep their hands off.

Some recent events, notably the collision on the N. Y., P. & O. Railroad, serve to illustrate the wisdom of the New York State Legislature in prohibiting the use of car stoves within the State. There is no longer much if any doubt as to the feasibility of heating cars by steam, and it would seem as though the object lesson afforded by one State requiring it, as the result of the roasting alive of a number of people, would be sufficient to cause all the other States to enact similar laws, especially after the practicability of steam-heating had been demonstrated. But it is much to be doubted if anything much short of the roasting of a car load of people in each State, during a session of the respective legislatures, will bring about the much needed reform all over the country.

We See that one of the New York papers has perpetrated the following upon the chief engineer of Cramp's shipyard:

"The designer of the cruiser 'Vesuvius' is Horace See, of Philadelphia. Our naval department is glad that it went to See."

Literary Notes.

Howard Challen, 150 Nassau street, New York, publishes what he calls the *Engineers' Log Book*. It is a blank book containing a leaf for each week in the year, one page having proper headings for daily observations, while the opposite page is blank for such observations, account of repairs, etc., as an engineer may wish to enter. The price of the book with flexible cover is 75 cents; half roan, $1.00.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

In answer to Question 45 we stated that the diameter of a plunger having an area of 0.235 square inch is nearly 3-32 of an inch. In place of 3-32 read 35-64.

(58) F. A. S., N. J., writes: Please tell me if it is necessary to put salt between the timbers of a steam launch hull? *A.*—Salt is often placed between the timbers of a hull for the purpose of preserving the timbers.

(59) G. T., East Saginaw, Mich., asks: Of what benefit, if any, is a dome on a boiler? *A.*—A dome provides a reservoir at a distance from the water in the boiler, and in taking steam from this reservoir water is less likely to be entrained than when steam is taken from near the water.

(60) "Trenton, N. J.," writes: I would like to have a simple rule by which I can figure out the gears to put on a lathe to cut fractional threads, such as 25-32, 11-16, or 9-32 pitch. We have a number of such pitches to cut in our shop, and I am at a loss to know how to get at it. *A.*—We refer you to Question and Answer No. 70 in this issue.

(61) W. E. P., Brooklyn, N. Y., asks how to ascertain the depth of a worm, the pitch being given, saying, "I want to cut a worm ⅞ inch pitch." *A.*—The depth is found in same manner as the depth of a rack tooth, and is equal to the depth of a rack tooth of the same pitch. Computing it by the diametral system the depth would be practically .6 in. By circular pitch .6125 or .61 in. The rule for the latter being to make the tool depth equal .7 of the pitch.

(62) B. S., Syracuse, N. Y., writes: I have started to build a common slide valve engine; the cylinder is 1-inch bore, 2½ inches stroke. Will you please tell me about how fast I had better speed it, and how large and heavy a fly-wheel I should use? *A.*—The speed of the engine will depend on the work it has to do. You may run it to about 300 revolutions per minute. The weight of the fly-wheel will also depend on the work the engine has to do; probably a fly-wheel 6 inches outside diameter, with a rim whose cross-section is a circle ⅞ inch diameter, may answer your purpose.

(63) J. T. W., Joplin, Mo., writes: Please tell me the objections to oil in a boiler. *A.*—Oil in a boiler will make it foam; when a boiler foams it is difficult, if not impossible, to determine the height of water: therefore oil in the boiler is decidedly dangerous, and may cause explosions. Besides this objection, heavy oils combine with the mud or impurities in the water, will settle in the bottom of the boiler and form a slush or paste; should this slush form on a sheet exposed to heat, this sheet may in time be burned, and cause considerable damage.

(64) C. H. H., Buffalo, N. Y., writes: I have some castings which are very hard, and have to drill them, and would like to know of some way to soften them without heating. *A.*—We do not think there is any way of softening them without heating. The process you speak of involved heating; your best plan is to write to a firm manufacturing good steel, tell them just what you want to do, and ask them to send steel for making a drill to do it with. You will probably have a good price to pay for it, but it will pay far better than attempts to soften the castings, even if such a thing were practicable.

(65) J. R., Glen Rock, Pa., sends us a sketch of a boiler and a 30-gallon tank; the latter contains a coil to heat the water used for washing purposes. The top of the tank is placed about 10 feet above the top of boiler; the distance from center of boiler to center of tank is about 6 feet 6 inches. Steam is taken from the top of boiler, and is led into the top of coil; the water due to condensation in the coil is led back into the boiler. Our correspondent then asks: I want to know whether I will experience any difficulty in getting rid of the air in the coil. *A.*—We do not see cause for any difficulty in getting rid of the air in the coil, and believe that you will experience none.

(66) J. F., Charleston, S. C., asks: 1. Can you give me a receipt that will keep brass from tarnishing after being dipped in acid, and if so, how long will it stand? *A.*—The only way is to lacquer it, and the length of time it will stand will depend upon the use to which it is put. If not subject to wear or heat, it will last for years if well done. 2. What kind of acid is best to bring brass to its original color, the same as when new? *A.*—We think the best plan is to scour it, but a mixture of aquafortis and water sufficiently strong to remove the dirt may be used. After dipping in this, wash in water and dry in fine sawdust. 3. What does the term lacquer mean—is it simply white shellac? *A.*—It may be either white or seed lac dissolved in alcohol. Sometimes other substances are added, such as "dragon's blood," for coloring.

(67) C. F. H., Buchanan, Mich., writes: What is the rate of evaporation obtained in steam boilers of modern construction? I have noticed that as much as 13 pounds of water from and at 212° Fahrenheit have been evaporated by 1 pound of anthracite coal. Is this equaled by the best practice at the present time? What is a good rate of evaporation when good bituminous coal is used? *A.*—We have seen it stated that 13 pounds of water have been evaporated from and at 212° Fahrenheit, but such results are not obtained in practice. We believe that 10 pounds of water evaporated per pound of coal may be called good practice. There is very little difference between the evaporations obtained by anthracite and bituminous coal; for all practical purposes we may consider the evaporations to be same for each. 2. How can I make a burner that will burn crude oil in boilers from 1 to 5 horse-power? *A.*—We have described in our issue of Nov. 12, 1887, an apparatus used for burning petroleum refuse on the Elevated R. R. in New York city. This apparatus with a slight modification may answer your purpose.

(68) A. S., Minneapolis, Minn., writes: I have a portable engine, cylinder 7x10 inches. The boiler is of the locomotive type, with water bottom; diameter of shell, 28 inches, fire-box, 32 inches long; number of tubes, 30, 2 inches diameter and 66 inches long. The engine has a 2-inch throttle governor. Exhaust pipe 2½ inches, with blast nozzle 1½ inches diameter. Boiler pressure, 100 pounds. Number of revolutions, 200 per minute. What is the horse-power of engine? And what is the loss of power from back pressure caused by the blast nozzle? *A.*—We should estimate your engine to be 19 indicated horse-power. The back pressure due to the exhaust nozzle will, to a great extent, depend on the point of cut-off, which you do not give. The back pressure due to the blast nozzle alone may be in your case about 1 or 2 pounds per square inch, or even more. In any case it is always best to determine the back pressure by an indicator. 2. Would it be practical to use oil for fuel in the boiler? *A.*—Oil is often used for fuel; but in such cases the boiler is specially built for the purpose. It is doubtful if you can obtain an attachment to your boiler which will burn the oil and give satisfactory results.

(69) ——, Oakdale, Ga., writes: Please give the horse-power of two boilers, each is 66 inches diameter, 18 feet long, with sixty-four 4-inch tubes. *A.*—We should rate each boiler at about 90 horse-power. 2. Please give size of brick chimney; also give size of chimney for two boilers 54 inches diameter, 16 feet long, fifty-four 3½-inch tubes. Give size of opening at the base, size of foundation and thickness of wall. *A.*—The size of chimneys will depend on the amount of fuel burned. The two 66-inch boilers are rated at 180 horse-power; allowing 4 pounds of coal per hour per horse-power, there will be burned $180 \times 4 = 720$ pounds of coal per hour. For this you will need a chimney 36 inches diameter, or 33 inches square, and 80 feet high. Each one of the 54-inch boilers we should rate at 60 horse-power, making a total of 120 horse-power; adopting again a consumption of fuel of 4 pounds of coal per horse-power per hour, there will be burned $120 \times 4 = 480$ pounds of coal per hour. For this you will need a chimney 30 inches diameter, or 27 inches square, and 80 feet high. The size of foundation will depend on the kind of ground on which the chimney is to be built. Do not attempt to build these chimneys without first obtaining a correct drawing made by a competent engineer. 3. Will it be practical to run an underground flue 300 feet away from the boilers before entering the chimney? *A.*—The effect of the horizontal flues is to lessen the draft. Such flues should be of an area at least one-quarter greater than that of the chimney. When the horizontal flues are 300 feet in length, the areas of the chimney corresponding to the sizes given should be increased at least 20 per cent.

(70) G. E. M., Plainfield, N. J., writes: Please give a rule for cutting any thread on any lathe? *A.*—If the lathe is simple geared, and the stud runs at the same speed as the spindle, then select some gear for the screw, and multiply its number of teeth by the number of threads per inch in the lead screw, and divide this result by the number of threads per inch which you wish to cut. This will give you the number of teeth in the gear for the stud. If this result is a fractional number, or a number which is not among the gears which you possess, then try some other gear for the screw. But if you prefer to select the gear for the stud first, then, multiply its number of teeth by the number of threads per inch which you wish to cut, and divide by the number of threads per inch on the lead screw. This will give you the number of teeth for the gear on the screw. If the lathe is compound, select at random all the driving gears, multiply the numbers of their teeth together, and this product by the number of threads you wish to cut. Then select at random all the driven gears except one; multiply the numbers of their teeth together, and this product by the number of threads per inch in the lead screw. Now divide the first result by the second, and you will have the number of teeth in the remaining driven gear. But if you prefer, you can select at random all the driven gears. Multiply the numbers of their teeth together, and this product by the number of threads per inch in the lead screw. Then select at random all the driving gears except one. Multiply the numbers of their teeth together, and this result by the number of threads per inch of the screw you wish to cut. Divide the first result by the last, and you will have the number of teeth in the remaining driver. When the gears on the compounding stud are fast together, and cannot be changed, then the driven one has usually twice as many teeth as the other, or driver, in which case you can, in the calculations, consider the lead screw to have twice as many threads per inch as it actually has, and then ignore the compounding entirely. Some lathes are so constructed that the stud on which the first driver is placed revolves only half as fast as the spindle. You can ignore this in the calculations by doubling the number of threads of the lead screw. If both the last conditions are present, you can ignore them in the calculations by multiplying the number of threads per inch in the lead screw by four. If the thread to be cut is a fractional one, or if the pitch of the lead screw is fractional, or if both are fractional, then reduce the fractions to a common denominator, and use the numerators of these fractions as if they equaled the pitch of the screw to be cut, and of the lead screw respectively. Then use that part of the rule given above which applies to the lathe in question. For instance, suppose it is desired to cut a thread of 25-32 in. pitch, and the lead screw has 4 threads per inch. Then the pitch of the lead screw will be ¼ inch, which is equal to 8-32 inch. We now have two fractions, 25-32 and 8-32, and the two screws will be in the proportion of 25 to 8, and the gears can be figured by the above rule, assuming the number of threads to be cut to be 8 per inch, and those on the lead screw to be 25 per inch. But this latter number may be further modified by conditions named above, such as a reduced speed of the stud, or fixed compound gears. In the instance given, if the lead screw had been 2½ threads per inch, then its pitch being 4-10 inch, we have the fractions 4-10 and 25-32, which, reduced to a common denominator, are 64-160 and 125-160, and the gears will be the same as if the lead screw had 125 threads per inch, and the screw to be cut 64 threads per inch.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

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The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Berryman Feed Water Heater and Purifier. Benj. F. Kelley, 91 Liberty street, New York.

Drop presses, punches and shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, O.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

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R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

New Catalogue of Screw Plates, Taps, Dies, etc., just issued by S. W. Card & Co., Mansfield, Mass.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Fire Brick and Clay Retorts for all kinds of heating and melting furnaces. Borgner & O'Brien, Phila.

Selden Packing, for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Dynamos, Engines, etc., need Common-sense oil filters; great saving. C. F. Baker, Minneapolis, Minn.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Automatic Wire Straightening and Cutting Machinery, Tools, etc. Manufactured by Collins-Gibbons Mfg. Co., St. Louis, Mo.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Patents obtained. Patent litigation conducted. R. G. DuBois, Patent Attorney, 928-930 "F" street, Washington, D. C. Correspondence invited.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila., Pa.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N.Y.

The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.

A system of easy lettering, by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

Patterson, Jordan & Gottfried, 146-150 Centre st., N. Y. Metals, Machinery, Hardware, Tools and Supplies for Machinists, Mills, Engineers, Brass Goods Mfrs., Factories, etc. An extensive assortment of Bolts, Screws, Wire, Taps, Drills, etc., carried in stock.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Feb. 14, 1889 issue, 70 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 84 articles have thus far appeared up to and including the Feb. 7, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

E. M. Lewis will build a machine shop at Anniston, Ala.

The Lima (Ohio) Machine works will build a foundry 60x140 feet.

The Freeport Buggy Company has been incorporated at Freeport, Ill.

The Stark Company will build another cotton mill at Manchester, N. H.

The Ashland (Ky.) Foundry and Machine Works have been incorporated.

George Simpson will build a factory for making excelsior at South Gardner, Maine.

The Talladega & Coosa Valley Railroad Co. will build a repair shop at Talladega, Ala.

Frank Hiermann is building an addition 60x95 feet to his machine shop at Austin, Texas.

The Southern Pacific Railroad Co. contemplate building repair shops at El Paso, Texas.

The St. Charles (Mo.) Car Company has increased its capital stock from $350,000 to $1,000,000.

The Stark Car Brake Company, of Toledo, Ohio, has been incorporated, to manufacture the Stark car brake.

The Revolving Semaphore Company, Chicago, Ill., has been chartered, to manufacture signals and other railroad appliances.

The Enterprise Manufacturing Co., Birmingham, Ala., are agitating the question of building a cotton mill at Birmingham, Ala.

The Amoskeag Manufacturing Company, Manchester, N. H., will make an addition to their cotton mills 100x500 feet, two stories.

It is expected that the large foundry to be built by the Edgar Thomson Steel Works, Pittsburgh, Pa., will be completed early in the spring.

The Morgan Engineering Co., Alliance, Ohio, have 14 acres of land and are adding considerably to their works. They expect soon to put an electric crane on the market.

The Howells Mining Drill Company, Plymouth, Pa., have issued a circular descriptive of a great variety of mining machinery made by them. The circular is quite fully illustrated.

The Remington Agricultural Co., Ilion, N. Y., send us a catalogue of their horse-power fire engines. The engine is illustrated and described, and its advantages over hand engines fully set forth.

The Holly Mfg. Co., Lockport, N. Y., have issued a circular, giving weekly duty reports of the Gaskill pumping engine at Saratoga Springs, N. Y., also the duty of several other Gaskill pumping engines.

The works of the Ette & Henger Manufacturing Company, St. Louis (Mo.), were recently destroyed by fire. This company manufacture hardware and plumbing goods. The works will be rebuilt at once.

The Springfield (Mo.) Car and Foundry Co. was recently incorporated, with a paid-up capital of $50,000. The company propose to build shops, having a ten acre lot for the purpose—a machine shop, foundry and car shops.

On March 1st, Lodge, Davis & Co., of Cincinnati, will open a warehouse and salesrooms at the corner of Lake and Canal streets, Chicago. There will be two floors devoted to the storage and exhibition of their machine tools.

The Lackawanna Lubricating Co., Scranton, Pa., have issued a circular showing the construction and operation of their positive force grease cup. We understand the company is meeting with good success in introducing these cups.

The Clapp & Jones Manufacturing Company, Hudson, N. Y., which furnish fire engines and supplies, send us a neat catalogue, which is illustrated with cuts of their well-known fire engines. The catalogue is well worth preserving.

The Silsby Manufacturing Company, Seneca Falls, N. Y., send us a catalogue of steam fire engines and fire appliances; also wrecking pumps, steam heating apparatus, etc., made by them. The catalogue is very complete, and fully illustrated.

The well-known Wm. Rogers concern, Hartford, Conn., manufacturers of silver-plated goods, propose to establish a factory for the manufacture of table cutlery goods ready for plating, at Brattleboro, Vt. It is expected 200 to 300 hands will be employed.

The La France Fire Engine Company, Elmira, N. Y., have a very fine circular of their fire engines. The engine is a rotary, and the boiler the improved La France Nest Tube Boiler. The circular describes very fully the construction of the boiler, showing the details by cuts.

There is water-works agitation at Tarboro, N. C.; Newbern, Tenn.; Ennis, Texas; Wytheville, Va.; Morgantown, W. Va.; Provincetown, Mass.; Attica, Kan.; Whitewater, Wis.; Saltsburg, Pa.; Whitham, Mass.; Cawker, Kan.; Goldsboro, N. C.; Macomb, Ill.; Wyandotte, Mich.

At the recent annual meeting of the Hendey Machine Company, Torrington, Conn., it was voted to increase the capital stock of the company from $40,000 to $60,000, which has been paid in. This is to take care of the increased business of the company. The company expect to build, and to add new machinery.

The four new mills which are being built at Fall River, Mass., by the Fall River Iron Co., will have a capacity of 46,500 spindles each. Each mill will be 286 feet long and 120 feet wide, and four stories high, and the four will form a square. The engine and boiler house and a large chimney will be between the buildings.

A new enterprise has been located in Springfield, Mass., for the purpose of making terra cotta goods. It will go under the name of the Bay State Terra Cotta Company. The men interested are B. S. Elmer, of Springfield and C. B. Doody, of Hartford, who have gained practical experience in the work in Connecticut and New York State.

The Brown & Sharpe Mfg. Co. enclose a small printed slip, reading as follows: We manufacture for general machine shop use and usually keep in stock, fifty different machines, 280 to 7,900 pounds in weight, also a large variety of tools, gauges and measuring instruments. These machines, tools, etc., are made with the best attainable appliances, and with the intention that they shall be the best of their respective classes. Catalogue mailed on application.

A Kokomo, Ind., paper says: From voluminous correspondence from Eastern manufacturers received by members of the Board of Trade we are safe in saying Kokomo will get about all the new factories she can handle the coming summer. Representatives of hundreds of industrial enterprises will make a tour of the Indiana gas cities in February and March, and will remove their works where the greatest inducements are offered for their particular line of manufacture.

According to the Oil City (Pa.) *Derrick* the Pipe Line Company are preparing to erect a mammoth building in addition to their already large works in the third ward, that city. The company have been taxed to their utmost capacity to fill the many orders for oil well pumps, etc., and are now behind almost three months with work. To facilitate matters, the Tarport shops will be abandoned, and the machinery will be taken to Oil City and added to that of the Pipe Line Shops, together with some new and improved machinery. The contemplated building proper will be 200x64 feet, and the wing 144x64 feet, giving about 264 feet frontage on the railroad. The material to be used is brick, with corrugated iron roofing. The building, when completed, will be used for machine, blacksmith and pattern shops. The present buildings now used for these purposes will be transformed into storage and warerooms.

The Merrick Thread Company, Holyoke, Mass., has just placed a compound condensing engine in the new mill. The fly-wheel is 26 feet in diameter, and the face measures 62 inches. It weighs 30 tons and carries two 30-inch belts. The engine was built by Hewes & Phillips, of Newark, N. J., and is capable of furnishing 600 horse-power. It is a compound, the high-pressure cylinder being 24 inches in diameter, with 60-inch stroke, while the low-pressure cylinder is 46 inch with a similar stroke. The steam cylinders are jacketed. The woodwork is black walnut, highly polished, and the finishings are of polished brass. The engine runs very smoothly and satisfactorily. The engine room, 38 feet wide, 58 feet long, and 15 feet high, is finished in quartered oak, with a stained maple floor. The room is light and airy, and at night is illuminated by Edison incandescent electric lights. Under the engine room is one of Wheeler's improved surface condensers, connected to the low-pressure cylinder by a 20-inch exhaust pipe. This condenser is supplied with condensing water from a head sufficiently great, so that the water after circulating through the tubes of condenser, passes to the tanks. This water being heated, and not contaminated with the exhaust steam, is very advantageously used in the bleachery and dye-house, thereby saving much fuel which would otherwise be necessary for heating the water required. The mill is equipped throughout with all the latest improvements.

Machinists' Supplies and Iron.

New York, Feb. 9th, 1889.

Iron—American Pig.—Southern competition has resulted in a reduction of standard prices for Grey Forge by the Thomas Iron Co., and although there has been no general change in quotations, prices very much lower than quoted have been generally accepted. We quote Standard Lehigh, No. 1 X Foundry, $17 to $18; No. 2, $16 to $16.50; Grey Forge, $15 to $15.25.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

First-class lathe hand wants position. Address Box 68, American Machinist.

Wanted—Position as pattern maker to work under instructions. Address Box 66, Am. Machinist.

Wanted—By a practical machinery pattern maker, position as foreman. Box 819, Hartford, Conn.

Wanted—Machine shop foreman; principal work marine engines; state age, nativity, experience, and salary expected. Machine shop, Am. Machinist.

Machinist desires situation; 14 years' experience in erecting and repairing paper-making machinery; references. Address Box 67, American Machinist.

Young man, college graduate, with some shop experience, desires position in drawing room; 2 years in this country. K. K., American Machinist.

Wanted—By practical pattern maker and draftsman, position as foreman pattern maker. S. K., American Machinist.

Wanted—Tool maker; competent man on tap and die work; must be well recommended. To the right man we offer steady employment and good wages. Address Ohio Brass, American Machinist.

Wanted—To make arrangements with a good house to travel with steam goods and special supplies; have had 14 years' experience; East or West; best of references. Address M., Am. Machinist.

Situation wanted by a designer of tools and automatic machinery; also a practical mechanic, or as manager with some enterprising manufacturing concern. Address C. P. B., American Machinist.

Wanted—By a first-class machinist, position as foreman, where ability will count; experienced at heavy hydrostatic machinery, marine, stationary and blowing engines; good draftsman; can handle men to best advantage; heavy work preferred. Address Competent, American Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Machinists.—Increase your income without capital or risk. See page 10, column 1.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State St., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Punches, Dies and special machinery built to order. C. F. Langston & Co., 70 N. 4th St., Phila., Pa.

The patent on scale for measuring pipe and fittings, as shown in American Machinist, Jan. 24, is for sale. W. L. Cheney, Hartford, Conn.

Wanted—Two or three steam specialties to handle exclusively, by party who will give them his whole attention. Address Specialties, Am. Machinist.

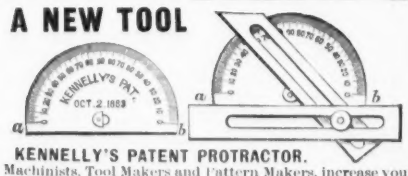
Roper's Engineer's Handy-book, the best book ever published for Engineers. Post free, $3.50. Send for list. Thos. Ordish, 1723 S. 7th st., Phila., Pa.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

The owners of Patents for the manufacture of improved Cast-iron Pulleys by a method that reduces the cost 40% below present processes, propose to license a few parties to manufacture. Correspondence solicited. Address "Pulley," Am. Machinist.

A NEW TOOL



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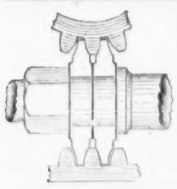

CLOUGH'S PATENT DUPLEX CUTTER

For cutting the teeth of gears; one Cutter cuts a pitch from 18 teeth to a rack inclusive.

Send for descriptive circular and price list.

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Combines the best elements essential in a first-class **Hammer**. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

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Pat. Aug. 30, 1887.

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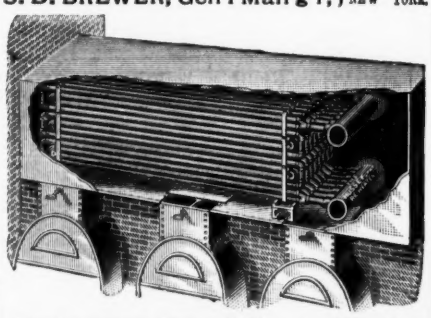

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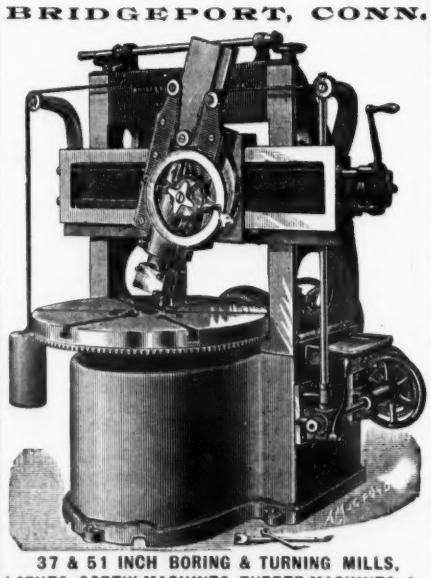

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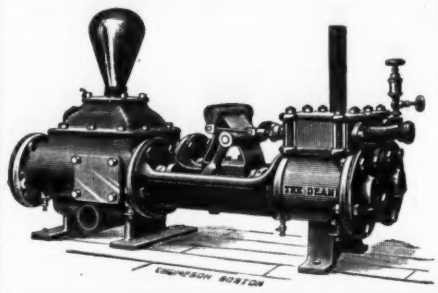

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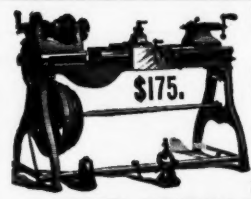

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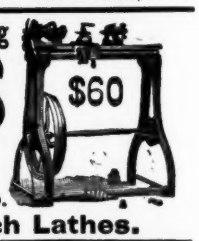

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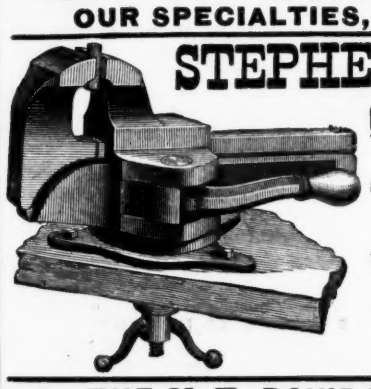

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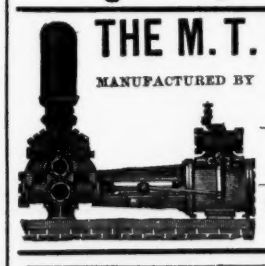

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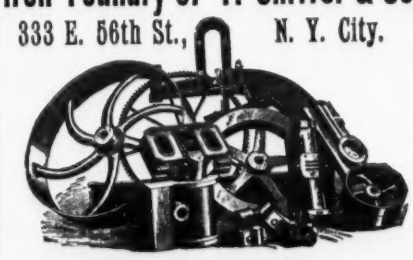

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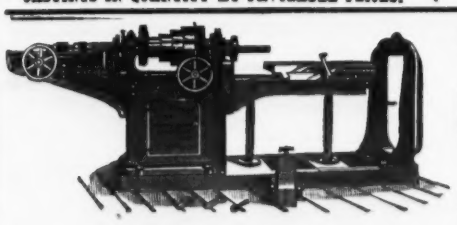

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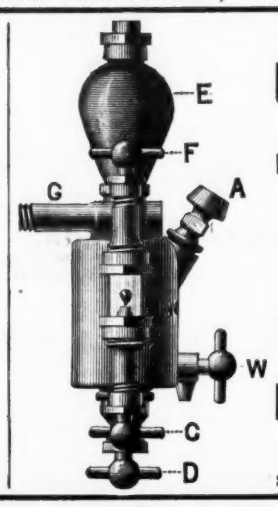

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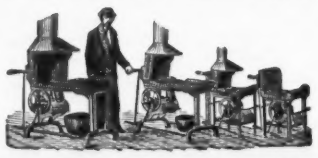

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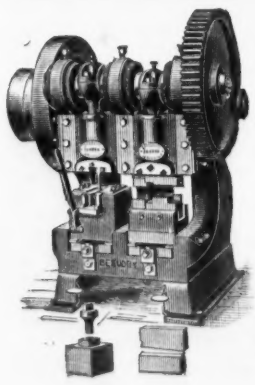

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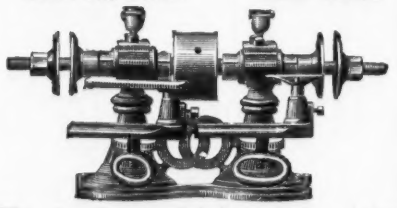

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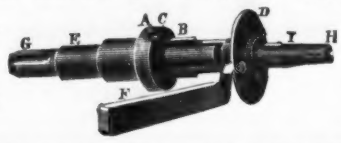

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2	1 " 1½ "	14
3	1½ " 2 "	18
4 (with screws)	2 " 3 "	32
5 " "	3 " 4 "	44

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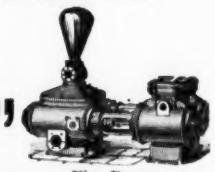
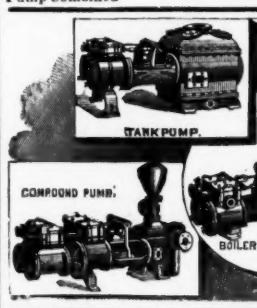


Fire Pump.



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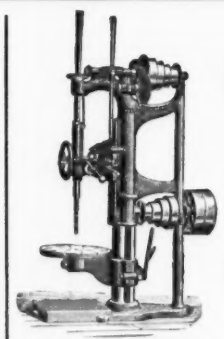

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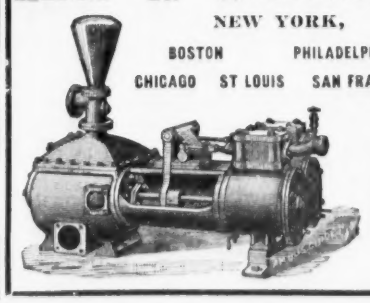

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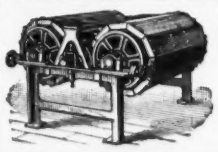

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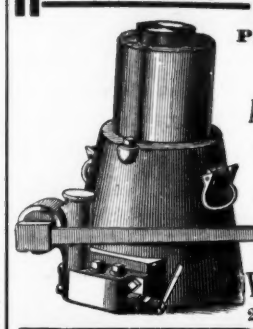

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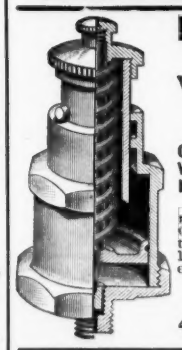

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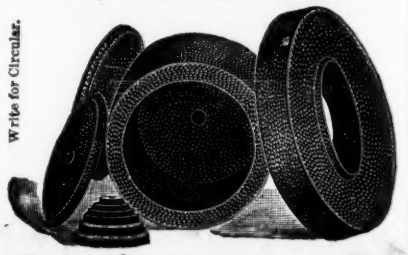

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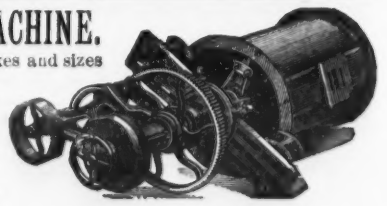

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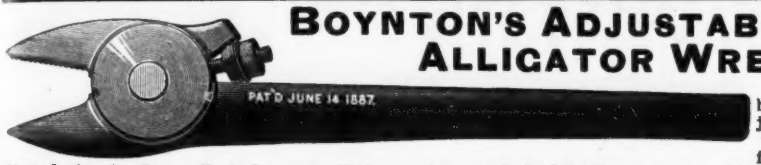

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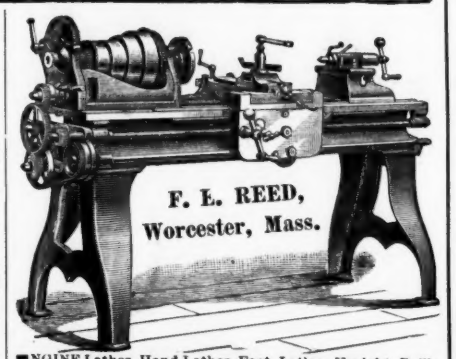

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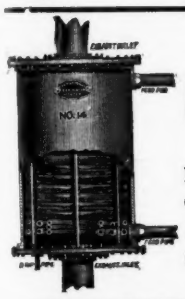

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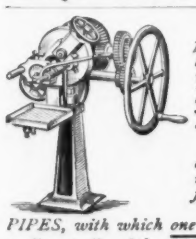

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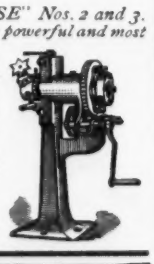

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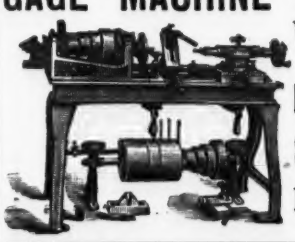

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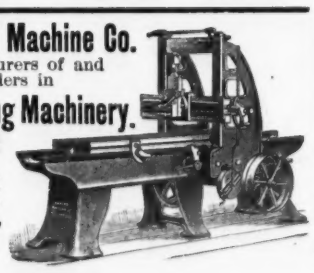

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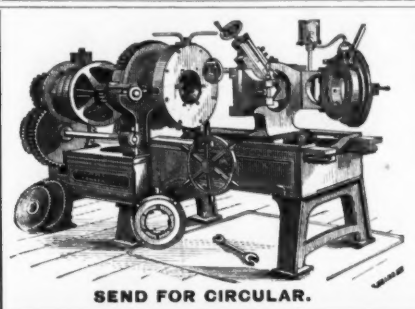

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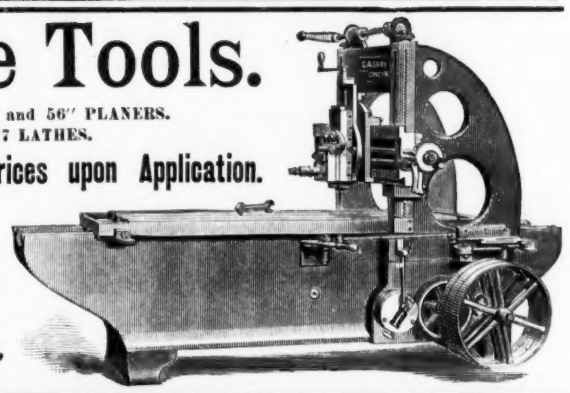

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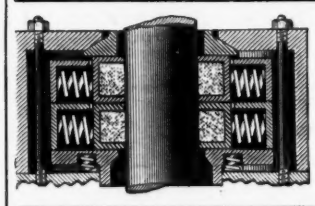

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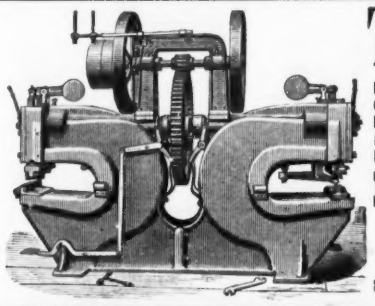

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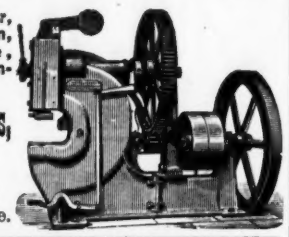

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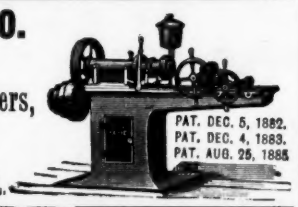

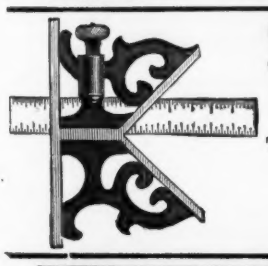

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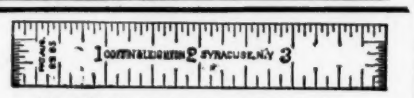

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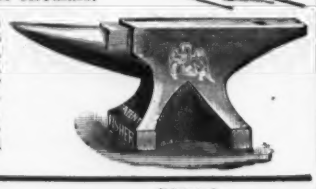

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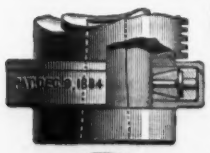

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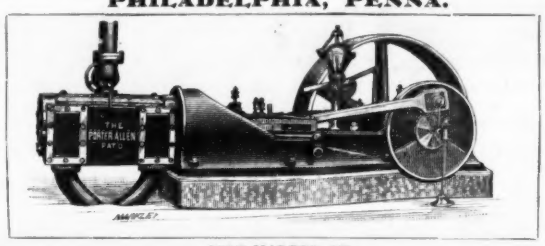

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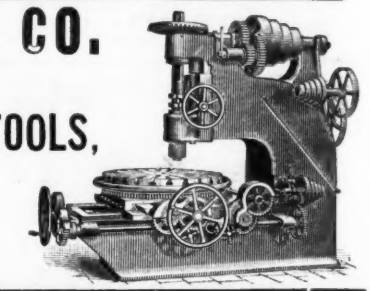

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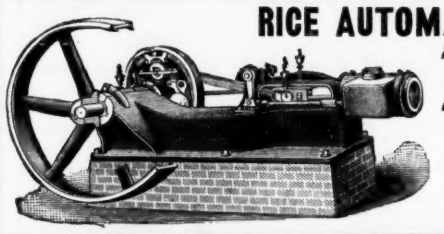

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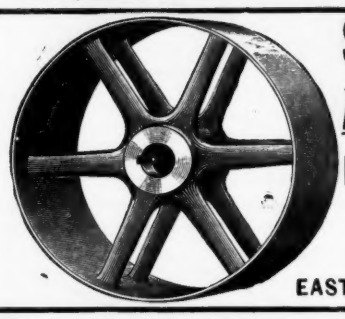

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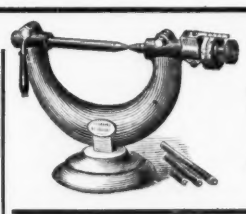

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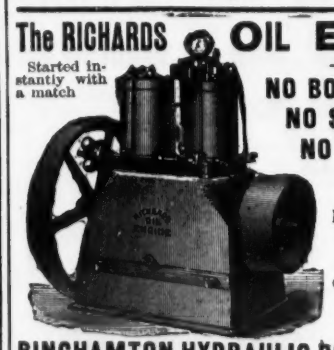

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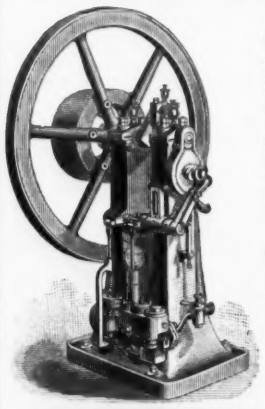

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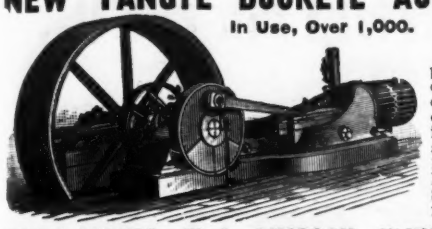

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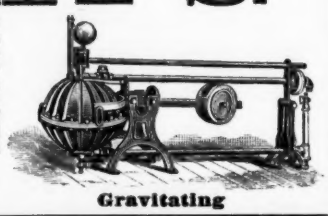

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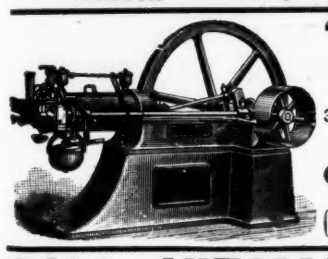

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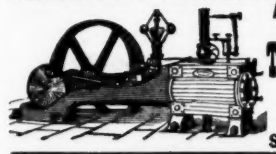

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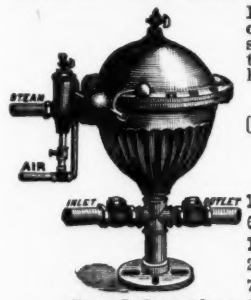

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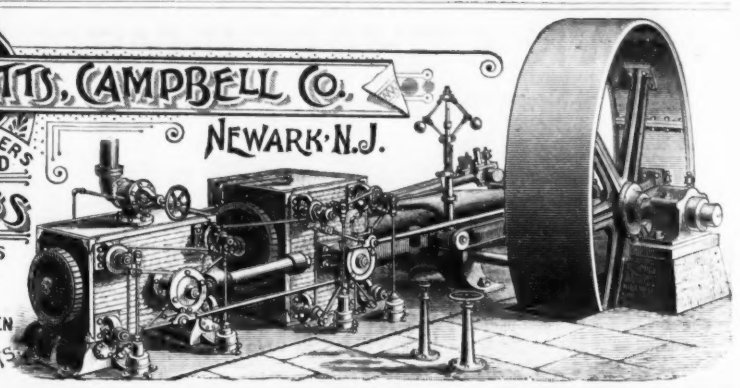

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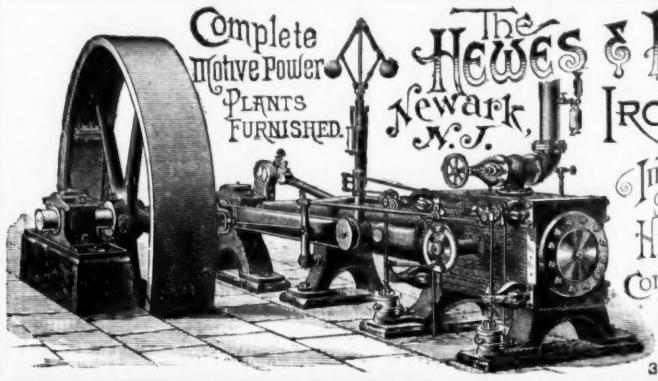

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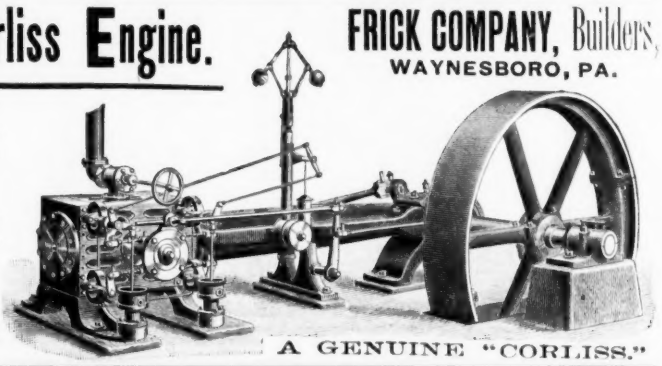

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ALSO SLIDE VALVE ENGINES

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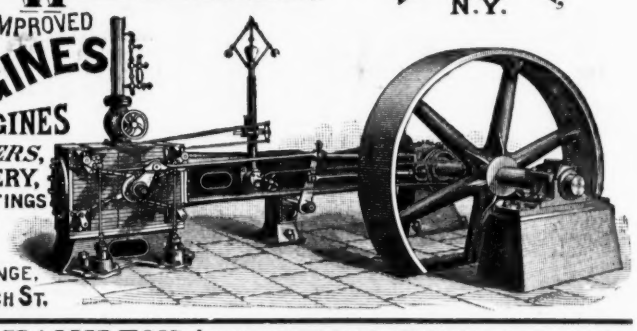
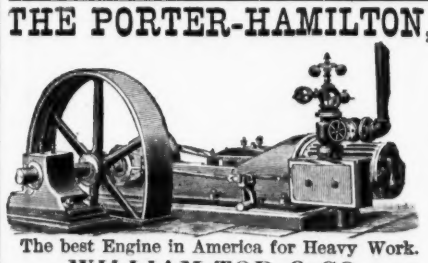


THE PORTER-HAMILTON,



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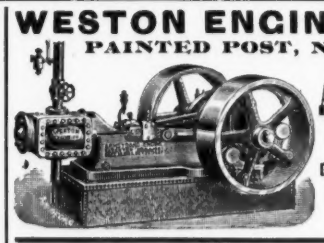

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ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

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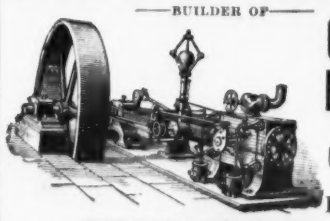

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List of Second-Hand MACHINERY

TAKEN IN TRADE FOR NEW.

10" x 5' Engine Lathe,	F. E. Reed.
12" x 5' Engine Lathe,	Prentice, (new).
15" x 6' Engine Lathe,	Lathe & Morse.
16" x 6' Engine Lathe,	Powell.
16" x 6' Engine Lathe,	Blaisdell.
16" x 11' Engine Lathe,	New Haven.
20" x 8' Engine Lathe,	Powell.
21" x 10' Engine Lathe,	Lathe & Morse, (new).
26" x 10' Engine Lathe,	Putnam Machine Co.
Cabinet Turret Lathe,	Lodge, Davis & Co. (new).
16" x 16" x 3' Planer,	Lathe & Morse.
24" x 24" x 6' Planer,	Chamberlin.
26" x 26" x 6' Planer,	Hendey.
30" x 30" x 8' Planer,	Bement.
36" x 36" x 10' Planer,	Whitcomb, (new).
42" x 42" x 10' Planer,	William Gleason.
15" Stroke Shaper,	Hendey.
20" Upright Drill,	Prentice.
22" Upright Drill,	Reed.

Above 2d-hand tools are in first-class condition. Write for list giving prices and descriptions.

We also carry much the largest stock of New Machine Tools in the country.

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BROWN & SHARPE MFG. CO.,

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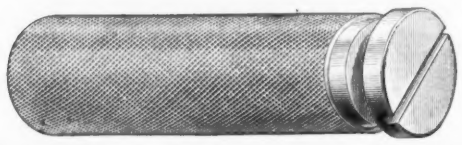

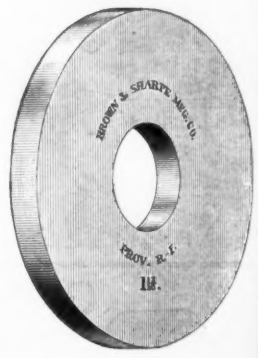

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For use in Setting Calipers, Testing Measuring Tools, and Reference for Sizes in Shop Practice.

They are made of steel, hardened and accurately ground to size. Price of complete set (45 disks and 6 handles), $35. Single disks from 60 cts. to $1.50. Single handles from 45 to 60 cts.

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Have reduced the Selling Prices

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Machine Screw Taps & Combination Lathe Chucks.

Send Specifications and ask for Terms.

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MANUFACTURERS OF

PURE COPPER COMMUTATOR BARS FOR ELECTRIC MOTORS OR GENERATORS,

STEEL COMMUTATOR RINGS AND NUTS,

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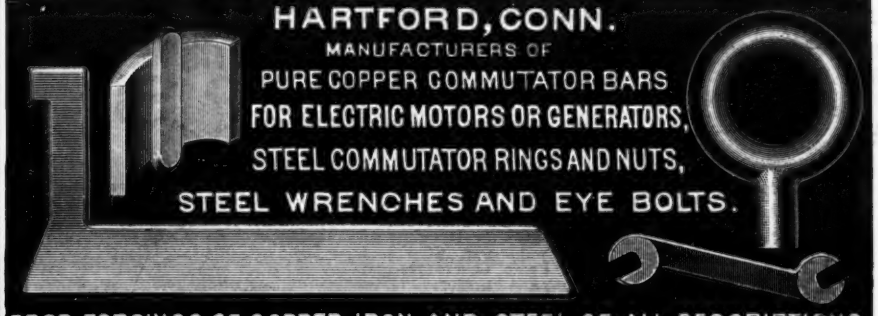

DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS.

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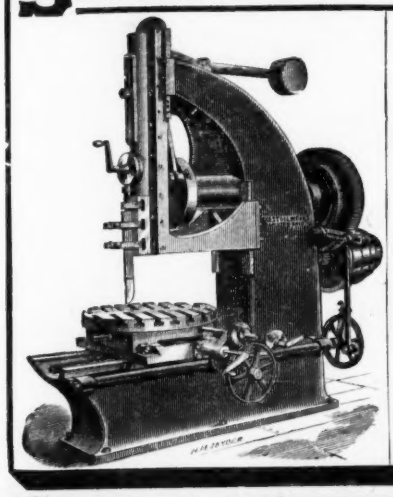

10 to 54 in. Stroke. New Patterns.

RAM GUIDE

ADJUSTABLE VERTICALLY.

Feed always takes place at upper end of stroke—never during cut.

VERY HEAVY AND POWERFUL.

NILES TOOL WORKS,

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MACHINE TOOLS CLEVELAND, OHIO.

For IRON and BRASS WORK.

Illustrated Catalogue on application.

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THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

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THE YALE & TOWNE MFG CO.
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The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

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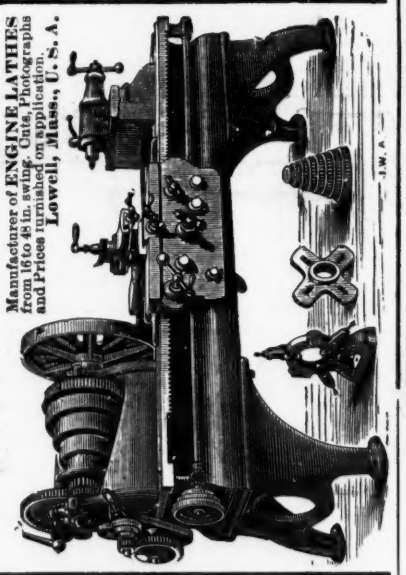

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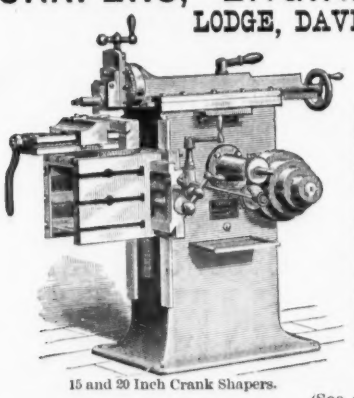
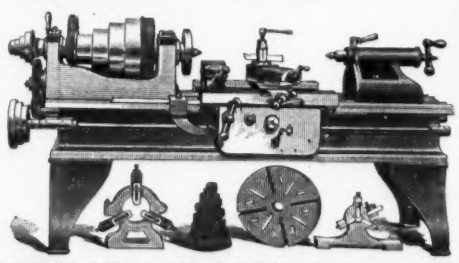


15 and 20 Inch Crank Shapers.

WRITE FOR PRICES, IT WILL PAY YOU.

20 inch Upright Drills. 25 inch Back Geared, and
24 " " " 28, 32 and 40 inch Power Feed Drills.



SHAPERS, 15″ and 20″ Crank. 20″, 26″, 32″ Geared.
ENGINE LATHES, 17″, 19″, 21″, 24″, 27″, and 38″.
(See advertisement, page 15.)

KEY-SEATING MACHINES AND 20 in. Drills a Specialty.

Our 20 in. Drill is a heavy substantial tool, made for service, has steel shafts and spindle. Gears and racks cut from the solid, and have all modern improvements, are made by special machinery, and sold very low.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seat Machines and 20in. Drills. Send for Photo. and Catalogue.

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Fine Machinists' Tools.—E. Boston, Mass—Send for Circular

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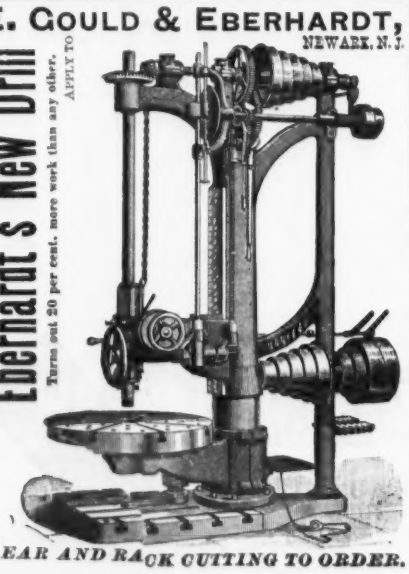
Eberhardt's New Drill

Turns out 20 per cent. more work than any other. APPLY TO



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Universal Milling Machine.

Manufacturers of Machinists' and Iron Workers' Tools, Lathes, Planers, Milling Machines and Drills. Special Tools for all kinds of manufacturing to order.

Gear and Rack Cutting, Milling and Index Drilling to Order.

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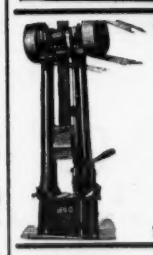

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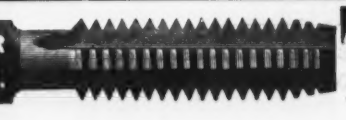

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